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THE WATER SUPPLY OF NASHUA, N. H.

BY HORACE G. HOLDEN, SUPERINTENDENT, NASHUA, N. H.

[*Read September 10, 1902.*]

Has it ever occurred to you what great changes have been made during the past twenty years in the water systems of this country? Formerly nearly all of the works derived their supplies from surface waters, either lakes, ponds, or running streams. These supplies were supposed to be unlimited in quantity and were apparently all right in quality; but the large increase of population, the building up of manufacturing industries, together with summer resorts on the shores of the lakes and streams, have caused many of the water supplies to be so contaminated with sewage, consisting of house drainage and mill refuse, as to not only render them unfit for domestic use, but also for steam boilers and other purposes where pure water is required.

To remedy this condition, filter systems were introduced on many of the works. Some of these have proved successful, while others have been failures; but it is doubtful if the average water taker can ever be convinced that liquid sewage can be so strained or clarified that it will not still remain liquid sewage.

For a period of forty-seven years, from 1853 to 1900, the city of Nashua, N. H., received its entire water supply from Pennichuck Brook, the outlet of a chain of ponds located in the town of Hollis. After leaving what is called the Big Pennichuck Pond the brook flows for six and one-half miles, as shown on the map, Fig. 1, forming the boundary line between the city of Nashua and the town of Merrimack, until it finally reaches the Merrimac River, about three miles above the Hudson Bridge.

In 1853 the water company built the first stone dam, about three-

fourths of a mile above the mouth of the brook. (Plate I, Figs. 1 and 2.) This dam is twenty-six feet in height, and the reservoir formed by it flows back eighteen hundred feet, to where another stone dam,

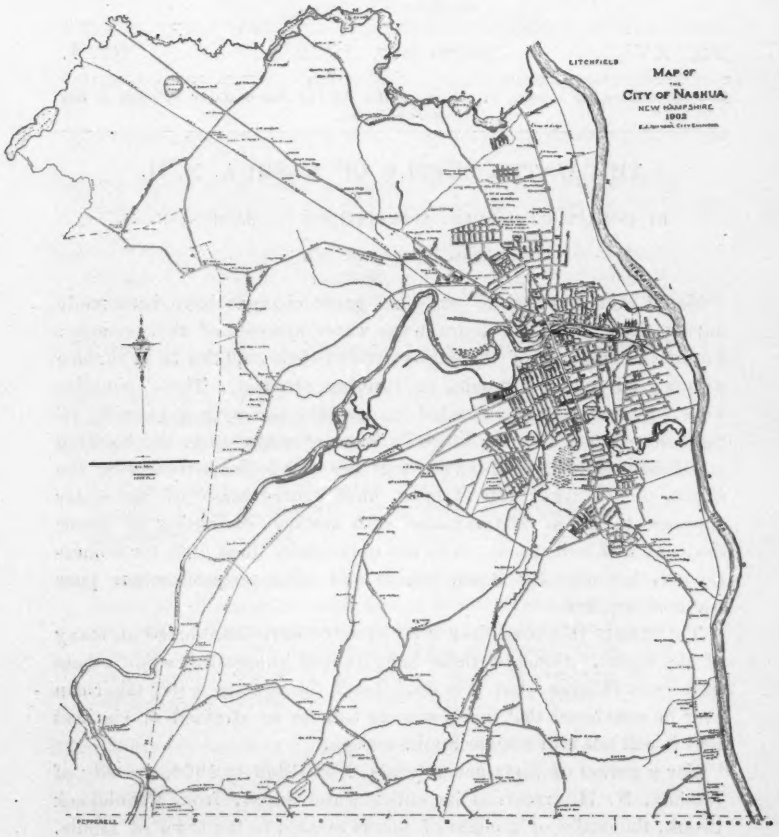


FIG. 1.*

thirty feet high, is located. Beyond this dam there are two more dams, each forming a reservoir of over a mile in length.

At the first or lower dam there are three pumping stations. The

*The upper part of the map shows the location of the Pennichuck Brook and reservoirs.

FIG. 1. — FIRST OR LOWER DAM ON PENNICHUCK BROOK. PUMPING STATIONS NOS. 1 AND 3.

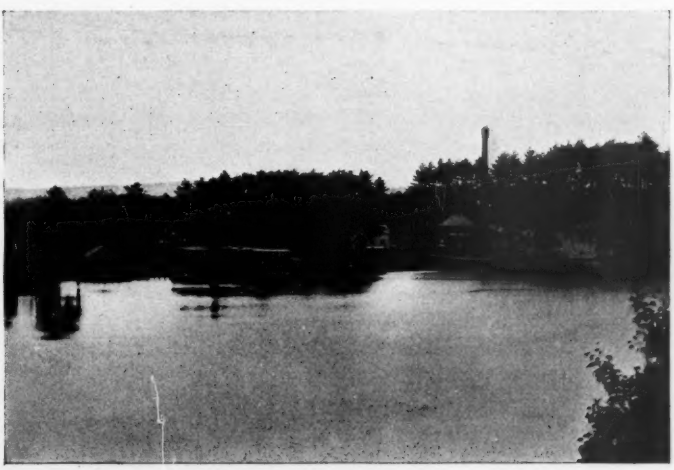


FIG. 2. — LOWER RESERVOIR AND PUMPING STATIONS.

No. 1 Station was built in 1853. It has a three-million-gallon steam pump and a two-million-gallon power pump. No. 2 Station was built in 1893, and has an eight-million-gallon triple expansion steam pump. No. 3 Station is located below the dam. It was built in 1900, and has a six-million-gallon power pump, the wheel driving it being run by water flowing through a seventy-two-inch steel penstock leading from the reservoir formed by the second dam, giving a head of sixty feet of water on the wheel. The second dam is shown in Plate II, Fig. 1.

The penstock is intended to be of sufficient size to carry all the water that ever runs in the brook, so that at present no brook water gets into the lower reservoir, from which is pumped the water now used by the city of Nashua.

The land on both sides of the brook from its mouth up to the fourth dam, a distance of three and eight-tenths miles, is now principally owned by the water company, which controls an area of nearly one thousand acres. This land was formerly used for grazing and tillage, but since coming into the possession of the water company it has been allowed to grow up into woodland, so that at present most of it is covered by quite a heavy growth of white pine, and this practically eliminates all danger of any outside contamination to the brook.

In 1892 Mr. Frederic P. Stearns, who at that time was the chief engineer of the Massachusetts State Board of Health, made a careful examination of the brook, and in his report to me mentions that the amount of albuminoid ammonia (organic matter) is unusually low. He also says: "I have compared it with a list of one hundred and four surface waters in Massachusetts and find there are but twenty-five lower, and seventy-nine higher. Of the twenty-five lower, all but two or three are mountain streams or small reservoirs fed by springs."

We have had here what might be considered an ideal water supply, with storage reservoirs of sufficient capacity to furnish a daily supply of at least ten million gallons of practically pure water, even in the dryest seasons, provided that the pumping was done by steam power. And even of late years the only question that has ever been brought up regarding the quality of the water was that, as is the case with most surface waters, there were times, especially in the spring of the year, when the water was discolored and also developed a decidedly swampy taste, undoubtedly caused by the meadows which line the upper end of the brook.

However, without much searching or any expectation of ever getting a better water supply, we accidentally came across one which is in every way superior to our brook supply.

About one eighth of a mile south of our lower reservoir there is a meadow containing about five acres, which has always been noted for having a number of springs of remarkably pure water. At times when our city water developed the swampy taste, many of the citizens of Nashua would occasionally drive up to these springs to fill their jugs and bottles with this spring water. The water company had owned this meadow for several years, and in order to accommodate those who preferred spring water, I laid a plank walk into the meadow to what was considered the best spring, and one day took up a twenty-four inch cement pipe, three feet long, such as is used in sewer work, intending to settle this pipe into the ground, so as to be nearly level with the surface of the water, then clean out the mud from the inside of the pipe, leaving a good well, from which the water could be dipped without affecting its clearness.

On ending the pipe up over the spring, I was surprised to find that by the time the pipe had settled a foot into the meadow, the water came up inside the pipe so as to flow over the top, which was about twenty-four inches above the level of the surrounding ground.

The level of the meadow is twenty-four inches above the high-water line of the lower reservoir, and there was what had once been a water-course leading from the meadow to the reservoir, but which had been filled up with decaying vegetation, — dead trees, etc. After clearing out this channel, there was quite a flow of water from the meadow into the reservoir.

Just before reaching the reservoir, the water-course runs through a narrow gorge about ten feet wide, with nearly vertical sides some twenty feet high. At this point a small dam twenty-four inches in height has been built, with a weir for measuring the flow of water from the meadow. The flow over this weir was very uniform, never at any time being less than one million gallons per day, while the maximum daily flow was rarely over 1 250 000 gallons.

The next season I drove several two and one-half inch pipes in different sections of the meadow, and succeeded in getting a good stream of water to flow from each of them. I then sunk a six-inch wrought-iron pipe in the north section of the meadow to the depth of 32.75 feet. There is a continuous flow from this pipe of 274 gallons per minute, or nearly 395 000 gallons per day.

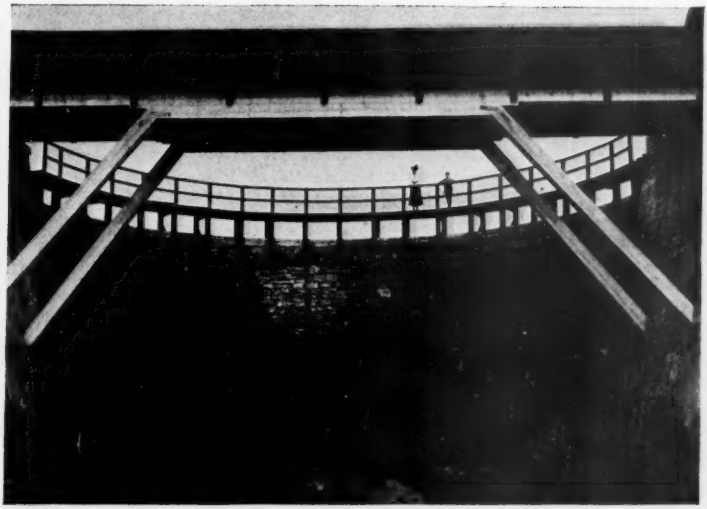


FIG. 1. — SECOND DAM ON PENNICHUCK BROOK.

FIG. 2. — THE PENNICHUCK SPRINGS. SHOWING THE 6-INCH AND TWO 2½-INCH FLOWING WELLS.

The surface of the meadow is covered with a layer of muck or loam, varying from one to six feet in depth. Below this, as was indicated by samples taken while driving the six-inch pipe, there appear to be alternate layers of marl, sand, fine gravel and coarse gravel, the water flowing mostly from the gravel layers. In driving the two and one-half inch pipes, a very good flow of water would occasionally be obtained from a depth of fifteen or sixteen feet, then, on driving farther, the flow would stop entirely, but on driving still deeper the flow would commence again.

Accurate measurements of the flow would be taken at every foot at which the pipe was driven, and after driving as far as could be easily done, the pipe would be drawn up to the place where the greatest flow was obtained. After driving the six-inch pipe previously mentioned, twelve 2½-inch pipes were driven, commencing at a point thirty-eight feet south of the six-inch pipe and running west in a straight line one hundred and sixty-eight feet, making the average distance between the pipes fourteen feet. Some of these wells are shown in Plate II, Fig 2. The depth at which the greatest supply of water was obtained from these pipes varied from sixteen feet seven inches to thirty-one feet eight inches. The flow from each pipe varied from 19.4 to 41.4 gallons per minute, the total flow from these twelve pipes being 352.9 gallons per minute, or 408 166 gallons per day.

Another line of six 2½-inch pipes was driven at the extreme southerly end of the meadow, the average distance between the pipes being seventeen and one-half feet. The greatest flow from these pipes was obtained at from thirty-six to fifty-two feet in depth, this flow being from 23.1 to 46.1 gallons per minute. The total flow from these six pipes is 273 744 gallons per day.

There is a daily flow from the six-inch pipe, and the eighteen 2½-inch pipes, amounting to 1 127 520 gallons. During the past three years I have frequently measured this flow and found but slight variation.

These wells increase the flow of water over the weir to about two and one-half million gallons per day, and whenever the pipes are plugged, the flow on the weir decreases proportionally, showing that the surface springs are not affected by the wells.

From these tests, I feel confident that a large number of pipes might be driven in this meadow and a very large amount of water obtained.

The following is a report of an analysis of water taken from one of the surface springs by Henry J. Williams, of Boston, chemical engineer and analytical chemist.

	Parts per 100 000.
Total Solids	3.7
Volatile and Organic Matter	0.5
Fixed Solids or Mineral Matter	3.2

The mineral matter contains: —

Silica	trace
Sesquioxide of Iron	faint trace
Alumina	none
Lime	1.42
Magnesia	0.14
Sulphuric Acid	0.498
Chlorine	0.20
Degree of Hardness	1.5
Free Ammonia	0.001
Albuminoid Ammonia	0.003

The above results show very plainly that this "spring" water is a very soft and unusually pure water, both in its freedom from organic matter and its freedom from mineral matter. Its purity in these two respects is unusual, and it is, therefore, admirably fitted for household use and for drinking. The amount of chlorine which the water contains is also very low, while the trifling amounts of mineral matter which are present are of entirely unobjectionable nature.

The constituents found in the analysis of the mineral matter occur in the water in the following probable states of combination: —

	Parts per 100 000.
Silica	trace
Sesquioxide of Iron	faint trace
Alumina	none
Sulphate of Lime	0.847
Carbonate of Lime	1.912
Chloride of Magnesia	0.210
Carbonate of Magnesia	0.126
Sodium Chloride	0.071
	3.166

The water also has a neutral reaction, that is, it is neither acid nor alkaline.

During the summer months the temperature of the water as it flows from the pipes is about forty-six degrees, but about the first of October the temperature gradually increases, and reaches sixty-three degrees by December, and by the last of April drops back to forty-six degrees. Professor Sedgwick informs me that this change of temperature is probably caused by the water flowing underground from a long distance, and if his theory is correct (as I have no reason to doubt) it may be possible that this water comes from a continuation of the underground river which Professor Denton, formerly of Harvard College, is said to have traced from Narragansett Bay to the New Hampshire state line, according to an item which was published in February, 1902, in several Massachusetts papers. This item related to the suit of Hollingsworth and Vose against the town of Foxboro, for taking water for water supply purposes from the Neponset River. The town claimed, however, that their supply, which is taken from wells, is derived from a subterranean river.

About one and one-half miles southwest of our springs there is another meadow similar to the one I have described, in which I drove a few pipes and was successful in getting flowing wells. This property is now owned by the United States Fish Commission, who get from flowing wells enough water to supply all the requirements of their fish hatcheries.

A NEW TURBIDIMETER.

BY CHARLES ANTHONY, JR., CIVIL ENGINEER, GLENVIEW, HEREFORD, ENGLAND.

[*Read September 11, 1902.*]

The determination of the turbidity of water is a factor which now occupies a more prominent position in deciding on the organoleptic qualities of a public water supply than formerly. Nevertheless, there are few points on which greater diversity of procedure exist; and among the many methods employed none can be considered altogether satisfactory.

These methods can all be resolved into one or other of the following three classes: —

1. The gravimetric.
2. The photometric.
3. The use of standards of comparison.

The first may be called the standard method, at all events from the water analyst's point of view. Indeed, formulæ have usually been applied to determinations by other methods, with the object of reducing them to equivalent weights of suspended matter in parts per million. But seeing that the finely suspended matter, consisting generally of clay and silica, is entirely harmless, and that it is only the appearance they impart to the water which is considered by the consumer, this proceeding appears unnecessary, not to say tautological.

The following are the principal methods hitherto employed in estimating turbidity: —

1. The gravimetric.
2. Lovibond's tintometer (colored glass standards, depth of tints varied).
3. Tidy's colorimeter (colored solution standards, thickness of solution varied).
4. Boston commissioners' colorimeter (colored glass standards, thickness of water varied).
5. Platinum and cobalt chloride standard (concentration of solution varied).

6. Silver chloride standard (concentration of solution varied).
7. Leed's Nessler standard (concentration of solution varied).
8. Stokes' Nessler standard (thickness of solution varied).
9. Kaolin standard (amount of kaolin varied).
10. Silica standard (amount of silica varied).
11. Horning's diaphanometer.
12. Hazen's platinum wire standard.
13. Salback's photometric method.

The first, or gravimetric, may be dismissed as being a difficult and tedious method, giving only approximate results, even in the hands of a capable water analyst, working in a well-equipped chemical laboratory.

The second, Lovibond's tintometer, is not well adapted to the examination of water, and is, as its name implies, not a measure of turbidity but rather of color. Its scale is, moreover, entirely arbitrary.

The third, Tidy's colorimeter, requires the preparation of standard solutions, has a restricted scale, and labors under the same disadvantages as the last.

The fourth, Boston commissioners' colorimeter, is open to the same objections as those above described.

The fifth, platinum and cobalt standard, though well recognized as a standard of color, is not a measure of turbidity, and is open to the same objection of arbitary scale as the above.

The sixth, seventh, and eighth are arbitrary standards which represent no rational scale, either as to the amount of suspended matter by weight, or amount of light absorbed.

The ninth and tenth are means of obtaining, by comparison with known standards, an approximate idea of the weight of matter in suspension, more easily than by the gravimetric method.

The eleventh, twelfth, and thirteenth are methods depending upon photometry. The eleventh, Horning's diaphanometer, depends upon the limiting depth at which an object remains visible through a tube of water; the twelfth, Hazen's platinum wire, upon the depth at which a platinum wire of one millimeter diameter becomes invisible in the water under examination; and the thirteenth, Salback's, is simply a photometer of cumbersome construction, necessitating the use of two artificial lights of equal intensity.

Of all these, as a turbidimeter in contradistinction to a colorimeter, the twelfth, Allen Hazen's platinum wire method, is the most practical. It is, indeed, the acme of simplicity, but labors under

two serious drawbacks: that its scale — the reciprocal of the depth in inches at which the wire becomes invisible — is entirely arbitrary, and that observations made under different conditions of illumination are not strictly comparable. It may be dismissed, therefore, as not a strictly accurate or scientific method, though useful in practice in certain cases on the score of simplicity.

From the above it may be seen that all hitherto employed methods are deficient, either on the score of difficulty and tediousness, or on account of irrational scale and deficient accuracy. In consequence some simple photometric method of measuring the absolute amount of light absorbed by a given thickness of water appears to the writer the most rational and convenient method of estimating the degree of turbidity of a water, and with this object he has designed the form of instrument illustrated in the following figure (Fig. 1).

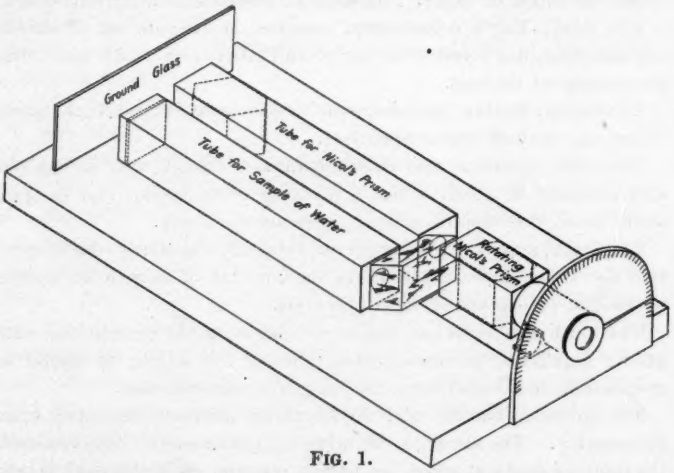


FIG. 1.

It consists, as will be seen, of a couple of parallel tubes of standard length, say fifty centimeters, one of which, closed at the ends by plates of glass, contains the water to be examined. Light transmitted preferably through ground glass reaches the eye, in part through this water and in part direct after passing through a Nicol's polarizing prism. These two sources of light are observed through an eyepiece containing another Nicol prism. The field of view is thus seen neatly dichotomized. By rotating the eyepiece, the illumi-

nation of that half of the field which received its light direct, seeing that it has already passed through a Nicol prism, can be varied until it matches the half receiving light through the standard thickness of water under examination. And though the inevitable difference in tint introduces some error due to personal equation in estimating equal obscuration, the extremely convenient manner in which the lights from the two sources are seen in absolute juxtaposition in the same field of view, allows of more accurate comparison than by any of the methods hitherto suggested. Further, seeing that the obscuration varies, according to a well-understood relation, with the angle through which the eyepiece is rotated, the instrument can be made to indicate, on a properly graduated disc, the degree of obscuration, that is, turbidity, to a rational scale, in which 1 represents perfect transparency and 0 total obscuration.

In conclusion it may be pointed out that the instrument is most easy to handle, gives accurate results to a rational scale, and is independent of the source of light. For these reasons the writer believes it well adapted to fill the long-felt want of a ready and standard means of making turbidity observations.

DISCUSSION.

THE PRESIDENT. I will call upon Mr. Hazen to say something upon the subject of Mr. Anthony's paper.

MR. ALLEN HAZEN.* Mr. President, this method of determining turbidity is an absolutely new one to me. It looks like a very interesting method; and I should very much like to see an apparatus constructed according to this illustration, and compared experimentally with some of the methods of measuring turbidity with which we have had practical experience.

The author seems to be not quite clear in his distinction between color and turbidity. The two things are so different that no one who has had experience with them both would think of measuring them on the same scale, and the author is evidently not quite clear as to the distinction when he lists the methods of measuring color with the methods of measuring turbidity.

The objections to the wire method, which the author mentions in so complimentary a manner, have been fully recognized by us for a long time. The method was based on methods which have been used from a very early time, and was put in use at Lawrence thirteen

* Civil Engineer, New York, N. Y.

years ago. Some work was being done for which a definite scale for recording the turbidities of certain waters was absolutely necessary. The scale was arbitrary. It had to be arbitrary. There were no data available at the time to make a scale in any other way. Since that time a great many data have been collected bearing on what a rational scale should be, and, as I hope to tell you this afternoon,* a scale has been constructed based upon these data which approximately meets the actual conditions, so that the figures as read are directly proportional to the amount of turbidity-producing material in the water. And this is, I believe, the object to be sought in making a turbidity scale.

The other objection mentioned to the wire method, that the results vary according to the light, is less serious in practice than might be at first supposed. Certain regulations are made in regard to the amount of light, which are followed as far as possible, and within the limits specified the differences do not cause a considerable error in the results.

There is a third source of error which seems to have escaped the attention of the author, but which is quite as important as those mentioned, and that is the differences in the eyes of different observers. This also is a matter which has to be guarded against, and is best done by comparing the readings of different people on the same water, and making sure that the observers whose records are relied upon have normal eyes and secure results approximately the same as those of other people with good eyesight.

The method of measuring turbidity proposed by the author is certainly a most interesting one, and I hope it will be investigated and compared with some of the other methods about which we know so much.

Mr. F. N. Connet.† Perhaps there are some others in the room who, like myself, once knew what a Nicol's prism is, but have forgotten. My recollection is that it is a polarizing instrument, but I am not quite sure of that. If there is anybody in the room who can explain it, I think it would be interesting to have it explained.

Mr. C. W. Sherman.‡ Mr. President, I will not attempt to give a scientific explanation of it, for my recollection is nearly as dim as

*See paper, "The Physical Properties of Water," to appear in the next issue of the Journal. — Ed.

† Mechanical Engineer, Builders Iron Foundry.

‡ Assistant Engineer, Metropolitan Water Works, Boston, Mass.

Mr. Connet's. I do not remember what the material of the Nicol's prism is, but I know it polarizes light, and with two Nicol's prisms, setting the planes of polarization at right angles one to the other, the polarized light can be entirely obscured. By a rotation, such that the plane of one prism will be at right angles with the plane of the other, the obscuration of light passing through the tube containing the first Nicol's prism would be complete, while with the planes parallel the light would be transmitted without obscuration.

That suggests a possible lack of sensitiveness in the use of this instrument, since there is only a ninety-degree angle of rotation from total illumination to total obscuration; reading on the silica standard of water, as we do on our Metropolitan supply, — where we read gradations of turbidity varying from two or three points at ordinary times to more than a hundred when the streams are in freshet, — and with the muddy waters of the West, they may go, for all I know, to a thousand; it would be decidedly difficult to read all the gradations that one might want in ninety degrees of rotation.

It seems to me that Mr. Anthony in devising this instrument has apparently gotten hold of a similar idea — not in making use of polarized light, but in the construction of the instrument — to that of the FitzGerald and Foss colorimeter which has been used for something over ten years on the Boston and Metropolitan Water Works, and which was described to this Association by Dr. Frederick S. Hollis three or four years ago.* That instrument consists of two parallel tubes, in one of which the water to be examined is placed to a standard depth, and into the other of which platinum and cobalt standard is forced by means of a bulb to a varying depth, until the colors are matched in an eyepiece constructed to show light from both tubes at once in the same way that Mr. Anthony's would do. It is, however, not a turbidimeter. I should judge that Mr. Anthony had not known of this colorimeter, because he does not mention it, although he lists color determinations as well as turbidity determinations proper in the methods which he states have been used with the intention of estimating turbidity.

I think perhaps Mr. Anthony was fully cognizant, or, at least, more fully cognizant of the difference between turbidity and color than Mr. Hazen infers, since he states, after listing these methods, that several of them are simply measures of color; but I think it is undoubtedly a fact, and probably that is what Mr. Anthony intended to convey, that

* JOURNAL, Vol. XIII, p. 94.

some of these methods have been used with the intention of estimating turbidity, although they are properly merely measures of color.

Mr. Anthony (by letter). In answer to Mr. Hazen's remarks I would observe that his new method of graduating the platinum wire turbidimeter had not been made public by the United States Geological Survey at the time my communication was prepared. Though this method is a distinct improvement on the original arbitrary one, I may point out that it is put forward as a tentative one, subject to alteration, and that it does not overcome errors due to differences in observers or in observing conditions.

The instrument I suggest would, of course, as Mr. Sherman points out, have a range embraced within a rotation of ninety degrees, seeing that the intensity of the transmitted light varies as the square of the sine of the angle comprised between the principal plane of the Nicol's prism and the plane of polorization. But this does not constitute a limitation of the instrument, as any degree of obscuration from perfect transparency to absolute opacity can be read upon the disc, if this is properly graduated over an arc of ninety degrees, to a rational scale on the basis of the above well-known law connecting the rotation with the percentage of light transmitted.

I must thank Mr. Sherman for recognizing that I was perfectly cognizant of the difference between determinations of turbidity and color, and that I only mentioned many of the methods employed with the object of showing that they had been improperly used.

I had not before heard of the colorimeter mentioned by him, but I have since read an account of it by Dr. Hollis in his paper on "Methods for the Determination of Color, and the Relation of the Color to the Character of the Water."

It is in no sense a turbidimeter, but simply an instrument for carrying out comparisons with any existing or other fluid standards rapidly and accurately, by varying the thickness of the latter. For this purpose it is the most ingenious and practical piece of apparatus I have yet seen described. The arrangement by which the light from two sources is brought into the same field of view only differs from that employed in my instrument in that two Nachet prisms take the place of one Wenham prism.

It will be seen that it thus in no sense trenches on the functions of the latter instrument, which has as an object the establishment of an absolute and rational photometric scale for turbidity estimates.

REPORT OF THE COMMITTEE ON UNIFORM STATISTICS.

[*Presented September 11, 1902.*]

BOSTON, September 10, 1902.

TO THE NEW ENGLAND WATER WORKS ASSOCIATION: —

Your Committee on Uniform Statistics presents the following report: —

During the year a considerable progress has been made in uniform water-works statistics. Perhaps the most important gain has been the adoption by the American Water Works Association and by the Central States Water Works Association of our form for summarizing statistics, so that all the water-works associations of this country have now adopted, and recommend their members to use, a single standard form.*

We are also pleased to report an increase in the number of water works reporting statistics in accordance with the standard summary, and greater uniformity in following the standard form. This appears to be the result of sending out blanks containing the headings of the standard summary.

The form endorsed nearly a year ago, which is a slight modification of the first form adopted by the Association, has proved generally satisfactory. We would, however, recommend a few slight changes, principally in the arrangement of items. The most important change proposed is the consolidation of the financial items into one table, instead of having separate tables for maintenance and construction, as heretofore. All the items of the summary as now used would be retained, and two or three new ones added; and it is believed that a seeker for information would be able to find the items he desired to use more easily in the proposed arrangement than in the one now in use. The proposed grouping is also in line, in a general way, with the scheme of the National Municipal League, and is thus a step towards uniformity with other societies.

The proposed new arrangement of the Financial Statistics, which was suggested by President Merrill, is as follows: —

* Since the above report was presented, the American Society of Municipal Improvements has also adopted the New England Water Works Association form. — ED.

RECEIPTS.	EXPENDITURES.
Balance brought forward:	*Water Works Maintenance:*
(*a*) From ordinary (maintenance) receipts, $.....	AA. Operation (management and repairs), $.....
(*b*) From extraordinary receipts (bonds, etc.), ...	BB. Special:
Total, $.....	.....
From Water Rates.	....., ...
A. Fixture rates, $.....	CC. Total maintenance, $.....
B. Meter rates, ...	DD. Interest on bonds, ...
C. Total from consumers, $.....	(CC + DD), ...
D. For hydrants, $.....	EE. Payment of bonds, ...
E. For fountains, ...	FF. Sinking Fund, ...
F. For street watering, ...	*Water Works Construction:*
G. For pub. b'ld'ngs, ...	GG. Extension of mains, $.....
H. For miscel. uses, ...	HH. Extension of services, ...
I. Gen'l approp'n, ...	II. Extension of meters, ...
J. Total from municipal depts., ...	JJ. Special:
K. From tax levy, ...	....
L. From bond issue, ...	....
M. From other sources:	....
....., $.....	KK. Total construction, ...
....., $.....	LL. Unclassified expenses:
	....., ...
	....., ...
	MM. Balance:
	(*aa*) Ordinary, $.....
	(*bb*) Extraordinary, ...
	Total balance, ...
N. Total, $.....	N. Total, $.....

Disposition of balance, ...

O. Net cost of works to date . . . . . $.....

P. Bonded debt at date . . . . . $.....

Q. Value of Sinking Fund at date . . . . . $.....

R. Average rate of interest, ... per cent.

Under the general heading of "Pumping" in the present form are two items, based on "Cost of pumping figured on total maintenance," reduced to "cost per million gallons" and to "cost per million gallons raised one foot." Being computed on the total expense of maintenance, this is not properly the cost of pumping, but rather the cost of supplying water, and should be applicable to gravity supplies as well as to pumping works. We therefore recommend that the items be transferred from Pumping Statistics to Statistics of Consumption of Water; that the cost per million gallons raised one foot (which would not apply to gravity works) be omitted, and that the two items appear as "Cost of supplying water, per million gallons, based on total maintenance (CC)," and "Cost of supplying water per million gallons, based on total maintenance, (CC) + interest on bonds (DD)." The former item should admit of comparisons between various works, while the latter, being dependent on the amount of bonds outstanding, would simply show the actual cost of supplying water under the particular circumstances.

When the Committee was continued at the last annual meeting, it was suggested that a form for summarizing statistics of purification works might be prepared and added to our present summary. Such a standard form seems very desirable, as there is at present a great lack of uniformity in the statistics kept at various purification works, and, indeed, at some very few data are kept. We have commenced the preparation of such a form, but there still remains a considerable amount of work to be done on it. We suggest that the Association authorize us, after preparing such a form, to give it a trial on several purification works before actually reporting it to the Association. This would not constitute an adoption of the form by the Association, but would enable us, at the next convention, to report with the form the results of its actual trial.

In brief, then, we report: —

First. A substantial gain in the adoption and use of our standard form of summary by the other water works associations and by water works.

Second. A recommendation of the adoption by the Association of a few slight changes in the standard form.

Third. Requesting authority to make trial use of the form for summarizing purification statistics which we now have in preparation

before reporting it to the Association, the result of the test, together with the form recommended, to be reported to the next convention.

Respectfully submitted,

JOSEPH E. BEALS,
GEO. F. CHACE,
J. C. WHITNEY,
M. N. BAKER,
CHARLES W. SHERMAN,
Committee on Uniform Statistics.

DISCUSSION.

THE PRESIDENT. Gentlemen, the report of the committee is now before you. We have with us this afternoon a gentleman who takes a great deal of interest in the subject of municipal accounting, and who, through his office as secretary of the Boston Statistics Department, and also as chairman of the Committee on Municipal Accounts and Statistics of the National Municipal League, is very well qualified to speak to us. I will call upon Dr. E. M. Hartwell to address us at this time.

DR. HARTWELL. *Mr. Chairman and Gentlemen of the Association*, — Perhaps I ought to explain my position. I came in here to hear the report of your committee, not expecting to speak. I do not wish to be taken for one who turns up wherever there is a chance to talk. I am reminded of an old black bath woman, an expert in a way on water matters, who had charge of the ladies' bath room at the White Sulphur Springs in Virginia. Her patience was somewhat tried by the ladies who were reluctant to bathe in her presence, and to such she used to say: "Don' you min' me, honey; it ain't no treat for me." [Laughter.] So while I am really interested in this subject I don't like to be thought too pleased at being called up to speak on it. That being understood, I am glad to express my thanks for the opportunity to tell you how this report has interested me. The report shows that the experience of your committee has been similar to that of the committee of the National Municipal League charged with the duty of drawing up schedules for the promotion of uniform municipal accounting and uniform municipal statistics. Our committee, like yours, has proceeded deliberately, and has asked to be continued so that we may test our schedules before recommending

their final adoption. It strengthens my confidence in our method of procedure to find that your method is of the same nature.

In general, the object of our committee is to establish a set of schedules to conform to the provisions of the municipal program of the National Municipal League, which was issued in 1899. In effect, the municipal program is a Municipal Corporations Act, intended to apply to all the cities in a given state, and to secure uniformity in administrative methods in the government of such cities. The legislature of Ohio has recently voted to establish a system of uniform municipal accounting, and is now considering the adoption of a general municipal act. The municipal program provides that the financial statistics of all cities, and the reports of city auditors or comptrollers, shall be made annually to a central office of control, for example, the state comptroller, in accordance with forms prescribed by the central office. Primarily our problem was to devise a set of schedules to conform to that scheme; at the same time we have sought to produce certain schedules which could be made use of now, inasmuch as for several years the Department of Labor at Washington has been called on under an Act of Congress to publish statistical tables relating to the financial operations of some one hundred and thirty cities of the United States. It is perfectly evident from a study of those tables that it is far from easy to reduce the material on which they are based to a common standard. Our committee, which has been at work for two years, has made two provisional reports, one at the Rochester meeting a year ago and a second at the recent meeting of the National Municipal League in Boston. Possibly we may be able to make a final report in May, 1903.

We have been fortunate in securing the experimental adoption of the principal schedule recommended in our report at Rochester. Thus the report of the auditor of Newton, Mass., for 1900, the report of the comptroller of Baltimore for 1901, and the reports of Mr. Harvey S. Chase (who is a member of our committee) on "The Accounts of Brookline, Mass., for 1901," and on the "Receipts, Appropriations and Expenditures of Boston for 1901," all contain a summary statement of receipts and expenditures drawn up in accordance with that schedule. Furthermore, the new scheme of bookkeeping and a new form of comptroller's report adopted by the city of Chicago at the instance of Messrs. Haskins & Sells, expert accountants of New York City, contain features recommended by our committee, of which Mr. Haskins is a member.

The Boston Statistics Department, of which I happen to be secretary, has published a study of Boston's receipts and expenditures for the fiscal year 1900–1901, consisting of seven tables based on the schedules recommended by our committee. You will find it published in Volume IV, No. 6, of the monthly "*Bulletin of Statistics*," of which I have a copy here.

In our second report to the National Municipal League, which is now in press, we have recommended a set of schedules embodying certain modifications suggested by the experience gained through testing the practicability of the schedules appended to our first report.

The two most characteristic features of our scheme are, (1) the separation of ordinary or maintenance and extraordinary or capital receipts and expenditures, and (2) the grouping of departmental receipts and expenditures under certain general heads, according to function; that is, General Government, Public Safety, — including Police, Fire, Health Departments, etc., — Public Works, Public Education, Recreation, and Art, etc. But I will not weary you by going further into the details of the scheme upon which we are still at work.

In the interesting report which your committee has just presented, the point has been made that the proposed statement conformed in general with the scheme of the National Municipal League — so it does. Yours is a consolidated statement showing ordinary (maintenance) receipts and expenditures on the one hand and extraordinary or construction (capital) receipts and expenditures on the other. If I may be allowed a suggestion, I would say that if the balance brought forward were divided to show how much was derived from ordinary and how much from extraordinary receipts, and the balance carried forward were similarly divided to show what was destined for the maintenance and construction accounts respectively, the schedule would conform very completely with our own. At least, that is my impression from such examination as I have been enabled to make through the courtesy of your committee.*

Thus far the committee of the National Municipal League has devoted itself mainly to the consideration of financial statistics. During the next twelvemonth we shall attempt to deal, to some extent, with other branches of municipal statistics, though we are well aware that in many branches chaos reigns at present. I devoutly wish there were a larger number of associations like this, — made up

* This was done in the form submitted, although the change had not been made in the copy shown to Dr. Hartwell. — ED.

of men trained in the application of scientific rules and formulæ. If there were, the collection and presentation of statistical data in respect to important and interesting forms of municipal activity would yield much more satisfactory results than is usually the case.

There is no lack of people anxious and ready to compare cities with each other in respect to death rate, the per capita cost of parks, of charities and correction, fire protection, water supply, and the like. But such comparisons are apt to be misleading, because of the difficulty of securing an accurate standard of comparison.

Even in the comparatively simple matter of death rates, comparative statistics are open to grave suspicion, because the estimates of population in intercensal years are so often vitiated by guesswork and vainglory. I need not urge the need of scientific methods in estimating population upon you who have to estimate the growth of population as a basis for forecasting the future needs of your cities with regard to water works, sewers, etc.

I shall content myself with citing a single illustration.

Some years ago an elaborate and interesting paper comparing the principal cities of the country with respect to taxation, the cost of public works, etc., was presented at the meeting of the American Society of Municipal Improvements. The writer gave the population of Baltimore as 500 000 by "official estimate," for the year 1898. A few months later an article appeared in the *Charities Review*, in which Baltimore was compared with other cities in respect to the per capita expenditures for outdoor relief of the poor, and the population of Baltimore for 1898 was officially estimated (so the writer said) at 625 270. At the same time the Baltimore Board of Health calculated the death rates for 1898 on the basis of a population of 541 000.

I asked the health officer how he got his figure. He said, "Independently, on the same day, I sent to the two principal newspapers of the city and asked what their estimate of the population of Baltimore was. One said 540 000, the other 541 000, and I took 541 000." The United States Census in 1900 found a population of only 508 957. If in comparing cities in respect to the death rate, per capita cost of public works, and poor relief, the standard for a given year varies between 500 000 and 625 000 of population, we may well consider such comparisons as scarcely worth the paper that they are printed on.

MR. F. H. CRANDALL. Mr. President, I move that the report of

the Committee on Uniform Statistics be accepted and adopted. By that I mean that their request and recommendations are endorsed by the Association.

(Mr. Crandall's motion is adopted.)

TWENTY YEARS AFTER. — A RETROSPECT.

BY ROBERT C. P. COGGESHALL, SUPERINTENDENT OF WATER WORKS, NEW BEDFORD, MASS.

[*Read September 11, 1902.*]

About two weeks since, I received a telephone message from the Secretary of this Association, asking if I would prepare remarks upon the topic which heads this paper, the same to be presented at this meeting. Finding that he had been disappointed in other directions in obtaining material for the program, I reluctantly consented.

I know that you would have been interested in a well-prepared review of the literary work contributed by the members of this Association since the date of its inception, over twenty years ago; but the time has been too brief for any attempt in that direction, and as most of you are familiar with the material which has been published, I shall have little to say touching that phase of the matter. I hope, however, to interest you in a sketch of reminiscences mainly drawn from the history of the Association from its earliest period down to the establishment of the JOURNAL in 1886.

The first question which may be asked is, "Who was the first to suggest an organization of this character?"

My reply is, James W. Lyon, then superintendent at Salem, Mass. While this story has hitherto been told, it never yet has appeared in the official publication of this Association, so it seems fitting that it should now be recorded.

As early as 1877 we find Mr. Lyon discussing the matter with neighboring superintendents. His idea then was the formation of a national association. He succeeded in arousing considerable interest, but his work did not immediately result in further development. During the next two years Mr. Lyon talked with every water-works official he happened to meet regarding the project. In March, 1879, he was induced to prepare a circular letter, which he mailed to every known water department in the United States and Canada.

The following is a copy of that circular: —

SUPERINTENDENT'S OFFICE, SALEM WATER WORKS,
SALEM, MASS., March 15, 1879.

Dear Sir, — Having for some time thought that the superintendents of water works throughout the country should have some way of becoming better acquainted with each other, and that it would be both pleasant and beneficial to all to have some kind of an organization and to meet in convention occasionally, to exchange ideas for the better management of the great interests we represent, I have ventured to propose the following questions to the superintendents and managing engineers of this country and the provinces.

First. Do you think it desirable to have such an organization?

Second. Is the project feasible?

Third. At what time of the year would it be best to hold the convention?

Fourth. Where is the best place to hold it?

Fifth. Would you probably attend such a convention?

Please answer, and add any suggestions that may tend to bring the subject in good shape before the fraternity.

Please address,

JAMES W. LYON,
Superintendent Water Works, Salem, Mass.

Mr. Lyon, in an address as President of this Association to the Worcester Convention in 1883, stated that four hundred copies of the circular were sent to various parts of the country, from which only seventy replies were received. He adds: —

"Of this small number there were those who thought the object a good one."

"Others replied that it was too comprehensive in taking in the whole country."

"There were others who thought that there was no need of such an organization."

"The lack of enthusiasm exhibited, together with the pressure of private interests, caused the abandonment of the project, although it was certain that if the project were carried into effect great good was sure to be the result."

A few years ago Mr. Holden, of Nashua, happened to meet Mr. Lyon at a Chicago convention of the American Water Works Association. At that time Mr. Lyon gave him a package of letters, which I now place before you to be deposited in the files of this Association. They are the replies which Mr. Lyon received in response to his circular. In looking them through I fail to understand how Mr. Lyon reached the conclusion stated, for to me they appear full of encouragement. It seems to me that if Mr. Lyon had

possessed more of the qualities of leadership, he would have experienced no trouble in effecting an organization at that time.

Let us briefly analyze these replies. The package contains fifty-six letters. Thirty-three are from localities outside of New England, almost every state east of the Mississippi River being represented. All are in sympathy with the project, and, with few exceptions, agree to be present at the first meeting. The range of location suggested for the first meeting was large. About one-half favored a "central location," most convenient to the largest number. There was the largest possible variation in ideas regarding the time, nearly an equal number favoring each season of the year.

One reply is worthy of reproduction. It is from one who later became prominent in the organization of this Association, and has remained one of its best known and strongest members. The language will be recognized as characteristic. He says: "I never have seen any superintendent but what I could learn something from, and any meeting of the kind you speak of would be a benefit to me; but as I might go to a convention of that kind to-day and have my head cut off to-morrow, I shall keep out. I will do my best to entertain any superintendent that may come here, and then I shall get the best of it, for if he is any way social he will be APT to tell me something that will be a benefit."

It is said that a wise man may change his mind. This is true in this case, for we all know that our dear friend Charles K. Walker, who wrote those lines, is lacking in neither wisdom nor good common sense. It is needless to say that he did not keep out, neither has he ever had his official head cut off.

In a few replies there appears the suggestion that it might be well to organize upon lines of limited territory. New England then contained one hundred and fourteen water departments. That territory might be the field of the work of one society, the Middle States of another, and so on. Then later a national society might be organized, of which the local societies would become branches.

Included in this list of replies were letters from W. L. Cameron, of Memphis, Tenn.; Ira A. Holly, of Burlington, Ia.; M. Donahue, of Davenport, Ia., and W. C. Stripe, of Keokuk, Ia. The enthusiasm of these gentlemen, once aroused, was not to be quenched. They heartily believed that the time was ripe for the organization of an association as proposed by Mr. Lyon's circular, and later we find them all prominently identified in the organization of the American

Water Works Association, which occurred at St. Louis, on March 21, 1881. W. C. Stripe took upon himself the responsibility of issuing the call for that gathering.

J. C. Briggs, of Terre Haute, Ind., took an active part in this organization. He was an enthusiast, as was shown a few months later, when we find him visiting several of the New England cities, and endeavoring by personal interviews to interest the department officials in the work so successfully inaugurated. His efforts were not fruitless. Interest in the project was easily secured, but the means of meeting the necessary expense in attending a convention at a distant center were not so clear to many. Indeed this phase of the question yet remains a serious obstacle to many in the attendance of our own conventions.

Such was the condition of affairs when three superintendents happened to meet, one bright winter's day, at Lowell, Mass. No previous appointment had been made; it simply happened by chance. On February 17, 1882, the writer took occasion to go to Lowell to acquaint himself with the inspection methods of the department of that city. For the first time he met Horace G. Holden, who then was the Lowell superintendent. During the morning Frank E. Hall, then in charge of the Worcester Water Works, called, on a friendly visit. Thus three officials met for the first time, all strangers to one another previous to that interview, but the friendships then formed developed into closer relationship with the passing years.

That day, while sitting around the dinner table at the Merrimac House, Mr. Holden called attention to Mr. Lyon's earlier efforts, and also to Mr. Briggs' more recent interviews in behalf of the American Association. A long discussion seemed to make clear the fact that New England offered a particularly good field for a helpful organization. While all were in sympathy with the work of the American Association, it seemed evident that the conditions and practices of the New England departments differed considerably from those of other regions of the United States. There was also the fact that there were such a large number of departments in a comparatively small territory that almost any of its centers were but a short distance from several water works. Thus several single-day meetings could be held in the course of the year, at which a good attendance could be secured, without much loss of time or burdensome expense on the part of the attendant. Such was the conclusion to which this discussion led, and after the dinner it was thought best

to attempt to enlist the interest of Henry W. Rogers, then superintendent at Lawrence, Mass. Accordingly Mr. Hall and the writer proceeded to Lawrence. Mr. Rogers had met Mr. Briggs, and was easily interested. It was agreed that the four gentlemen (Holden, Hall, Rogers, and Coggeshall) should constitute a self-appointed committee. Their first act was to write Mr. Lyon asking him to become a member of this committee and help in the work, to which he consented. The territory of New England was then divided into five districts, and each member of this committee took one of the districts for correspondence with the department officials located therein. All went to work, and a month later a comparison of returns was made. The success of the scheme seemed assured. The committee then decided to invite all interested parties within their districts to be present at a general meeting, to be held on April 19. I herewith present to the Association the original letter written by me at that time, from which the hectograph copies which were sent out were made.

OFFICE OF NEW BEDFORD WATER WORKS.
CITY HALL,
R. C. P. COGGESHALL, Supt
New Bedford, Mass., March 16th 1882

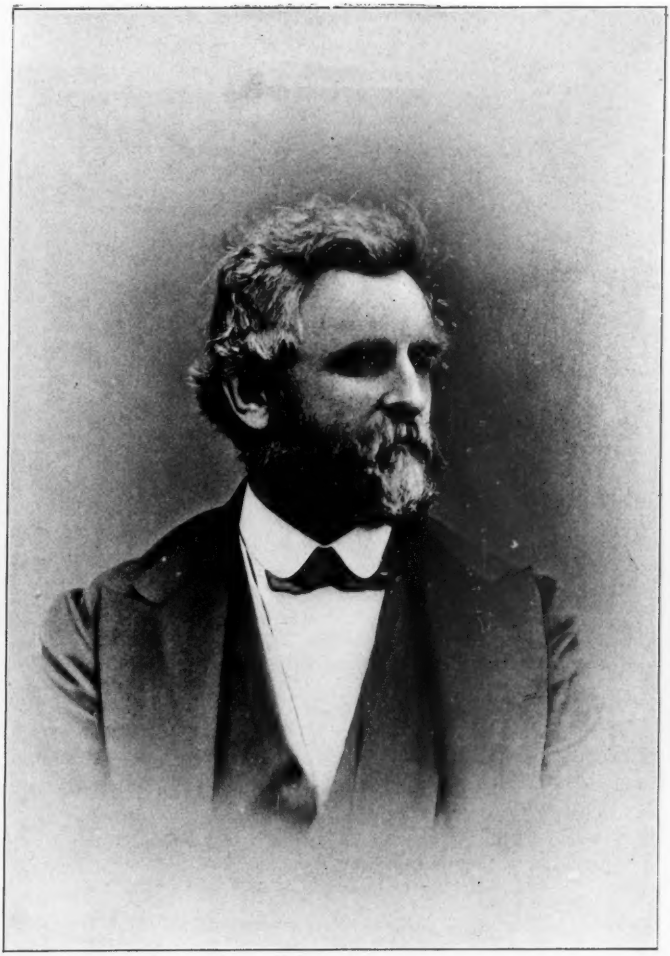
There is a movement being made to form an association of the water works managers of New England. This movement is endorsed by Mr. Lyons of Salem, (who was the first to suggest the formation of such an organization) Mr. Holden of Lowell, Mr. Hall of Worcester, Mr. Rogers of Lawrence and others. This association is to meet once or twice a year in convention and exchange ideas. No doubt much profit as well as pleasure will be derived from these proposed gatherings. In order that the organization may be an assured success it is both necessary and important that there be a large attendance at a preliminary meeting which will be held on Wednesday April 19th. The place of this meeting will be decided later, it will probably be Boston or vicinity. I am requested in the name of the informal committee mentioned above to extend an invitation to you to join the movement and to be present at the above named preliminary meeting. It is hoped that there will be a large representation of Registrars, Clerks, &c as well as Superintendents Should you find yourself interested we hope you will lend your influence by extending an invitation to be present at the preliminary meeting to all those whom you think would be interested.

Can you make it convenient to attend this preliminary meeting. If you wish I will advise you of the place of meeting as soon as it is decided

Yours truly
R. C. P. Coggeshall

FACSIMILE OF CALL FOR FIRST MEETING.

PLATE I.



JAMES W. LYON,

First President of the New England Water Works Association,
1882–1883.

The suggested meeting materialized at Young's Hotel, Boston, on April 19, 1882. There were nineteen officials present, besides other gentlemen. As many will be interested to know just who were there, I give the list: —

Thomas C. Lovell, Fitchburg, Mass.
Joseph C. Hancock, Springfield, Mass.
Frank E. Hall, Worcester, Mass.
A. H. Martine, Fall River, Mass.
W. F. Cleveland, Brockton, Mass.
R. W. Bagnell, Plymouth, Mass.
Edwin Darling, Pawtucket, R. I.
Charles K. Walker, Manchester, N. H.
Henry W. Rogers, Lawrence, Mass.
Hiram Nevons, Cambridge, Mass.
Horace G. Holden, Lowell, Mass.
J. G. Tenney, Leominster, Mass.
S. E. Grannis, New Haven, Conn.
W. W. Hawkes, Malden, Mass.
Robert M. Gow, Medford, Mass.
James W. Lyon, Salem, Mass.
Robert C. P. Coggeshall, New Bedford, Mass.
James H. Hathaway, New Bedford, Mass.
J. J. Whipple, Brockton, Mass.
John L. Harrington, Cambridge, Mass.
W. W. Cross, Brockton, Mass.

Also present were: —

John C. Kelley, President National Meter Co., New York.
Lewis H. Nash, M. E., Inventor Crown Meter.
C. C. Cowpland, Agent Davidson Steam Pump Co.
Ex-Gov. James A. Weston, of Manchester, N. H.

Mr. Lyon was elected temporary chairman and the writer temporary secretary. Messrs. Darling, of Pawtucket; Nevons, of Cambridge; Hall, of Worcester; Martine, of Fall River, and Walker, of Manchester, presented suggestions regarding the development of the plan of organization. Messrs. Darling, of Pawtucket; Grannis, of New Haven, and Nevons, of Cambridge, were appointed a committee to prepare the draft of a constitution and by-laws, the same to be submitted to an adjourned meeting.

An attempt was then made to start a "topical discussion," but no one seemed inclined to talk. Here was a body of nineteen strangers drawn together by a common interest, but with one or two exceptions all were unaccustomed to public speaking. More or less embarrass-

ment was evident. There occurred at this time an incident which did much in making every one feel more at ease. Charles K. Walker was describing his experiences with wrought-iron, cement-lined pipe. He had just declared that without the slightest provocation it would burst once in every fifteen minutes, and he was giving further vent to his feelings regarding it, when the door opened and a fine-looking, elderly gentleman appeared. Mr. Walker stopped his remarks and said something like this: —

"Gentlemen, I wish to introduce you one and all to my friend Ex-Governor Weston, of Manchester, N. H. He is deeply interested in our work. The governor and I started life together as boys, but brains will tell every time. He has risen to the high honor of being governor of New Hampshire while I remain a miserable superintendent of water works."

The characteristic tone in which these last words were uttered provoked shouts of laughter, and conversation became freer.

The adjourned meeting was held at Young's Hotel, Boston, on Wednesday, June 21, 1882. There were twenty-five officials present, Desmond FitzGerald, of the Boston Department, and Albert S. Glover, then water registrar of Newton, being among the newcomers. The committee appointed at the previous meeting presented the drafts of the Constitution and the By-laws. These were taken up in debate, a few changes made, and then adopted, after which the following officers were elected under the provisions of the constitution: —

President: James W. Lyon, Salem, Mass.

Vice-Presidents: Charles K. Walker, Manchester, N. H.; Hiram Nevons, Cambridge, Mass.; Edwin Darling, Pawtucket, R. I.; H. L. Schleiter, Meriden, Conn.

Secretary: R. C. P. Coggeshall, New Bedford, Mass.

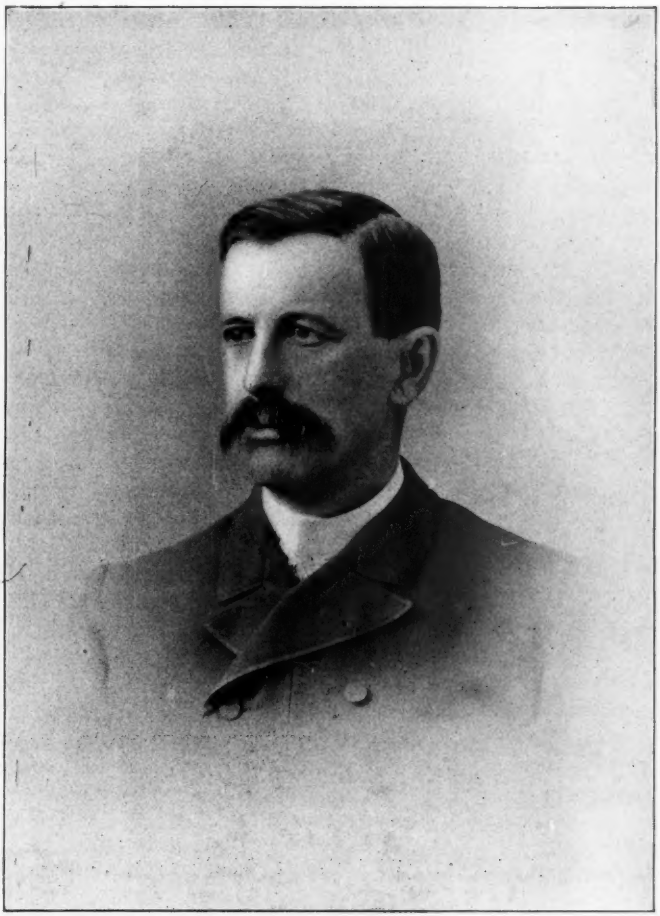
Treasurer: Edwin Darling, Pawtucket, R. I.

Executive Committee: The above named, with Frank E. Hall, Worcester, Mass.; A. H. Martine, Fall River, Mass.; J. G. Tenney, Leominster, Mass.

Financial Committee: J. Warren Cotton, Cambridge, Mass.; Horace G. Holden, Lowell, Mass.; Phineas Sprague, Malden, Mass.

That was twenty years ago. It seems as if it were yesterday. Through memory's eye I see the space before me alive with the faces of those who were present and who since have joined the silent majority. There was Cotton, the genial registrar of Cambridge; Nevons, the able superintendent of the same city; Darling, the energetic superintendent of Pawtucket; Lyon, the first President of the Association,

PLATE II.



FRANK E. HALL,

President of the New England Water Works Association,
1883–1884.

and Rogers, the well-equipped but exceedingly modest superintendent of Lawrence. Then there were Schleiter, of Meri[illegible]n, and Sprague, of Malden. All were prominent at that time, but now their voices are silent.

At a meeting held the following October, at Salem, there appeared for the first time the face of one of the sweetest characters I ever have met. He proved to be a strong addition to our forces, and was of great assistance in the early development of the Association. He later honored the Association by filling positions of trust, and finally he became its president for the year 1890–91. Of course I refer to Albert F. Noyes, whose tragic death in the Park Square Station, of this city, on October 12, 1896, we have never ceased to mourn.

The Association seems to have been slow in its development during the first year. The President, Mr. Lyon, was a large man, exceedingly amiable and having great interest in the work. But he was deliberate and ponderous in his mannerisms, and did not seem to possess the faculty of inspiring others. The writer was thoroughly "green" concerning best methods of conducting the secretary's work. So I always have thought that others possessing greater experience could have accomplished more that year than did we. One thing is certain, — the members became well acquainted with each other, so perhaps there was more of a solid foundation laid than at first sight appears.

At the second convention, at Worcester, in 1883, Frank E. Hall was elected President, and he proved an admirable choice. At that time the membership had reached forty-three. Not a large number, you will say, but the leaders of that day did not dream of a society of ambitious proportions, with its well-equipped accessories, as it now exists. Their ideas had rather the opposite trend, — a club of select membership, modest in numbers; the meetings to be more of the nature of social and informal gatherings, affording opportunities for the comparison and discussion of personal experiences.

Walter H. Richards, William R. Billings, George A. Ellis, and Charles H. Baldwin were present at this meeting, and took active parts in the proceedings. Later each of these gentlemen did an immense amount of work in our interest.

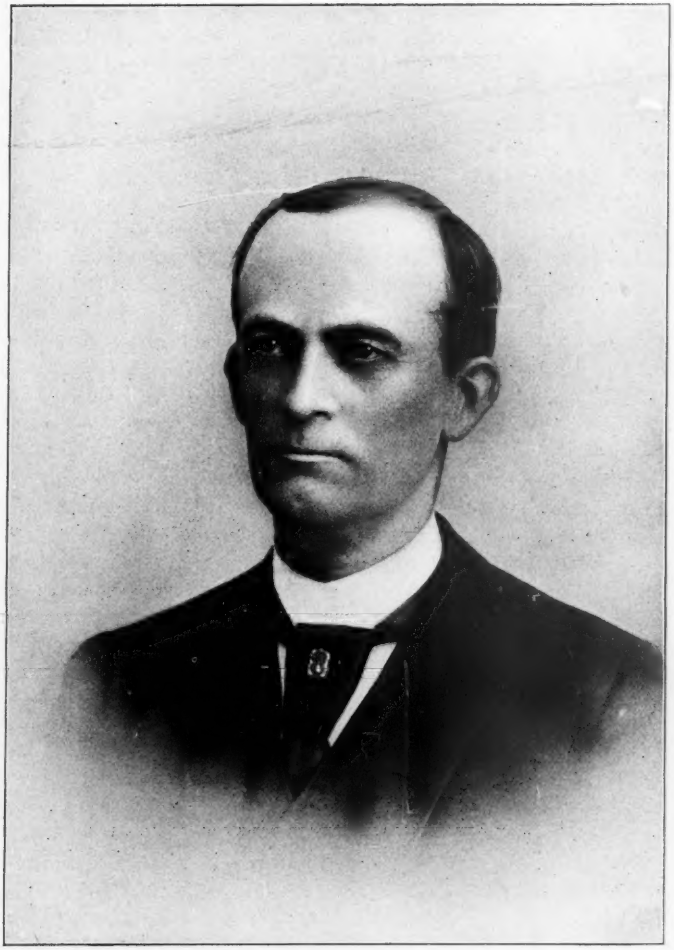
If you had been present at that convention you would have heard Darling (he was always energetic and positive in his discussions) maintaining that there were no hidden leaks upon his pipe system,

and that the only leaks that gave him trouble were those around the faucet. Nevons quickly took issue with this statement. He had given a great deal of attention to night inspection of the Cambridge pipe system, and had discovered many hidden leaks. Darling was an earnest advocate of the "meter" system, so he had the best of it when this question was considered, while Nevons hoped that the general application of meters to prevent waste of water would never come. He pleaded for a well-organized system of house-to-house inspection, which he thought would be more effective. In later years he was converted from that opinion, in company with many others.

The following fall the Association was entertained at Pawtucket, R. I. After sight-seeing about the town, a steamboat was taken for one of the shore resorts down the bay, where an excellent clambake was served. Many of you will remember the fine display of fire streams which Darling made as the boat passed through the draw of the India Point Bridge. We all passed under an arch of living water.

The third annual convention was held in Lowell, Mass., on June 19 and 20, 1884. The officials had worked hard, and they were rewarded for their efforts in having a convention which showed advance in the quality of the papers presented. Two especially able papers were read, one by W. H. Richards, of New London, and the other by H. W. Rogers, of Lawrence. The former attracted considerable attention outside the ranks of the society, and has reappeared many times in various publications. It was at this convention that William B. Sherman, one of the most conscientious workers of our early years, unfolded his scheme for the exchange of sketches. His plan called for an agreement on the part of each member to bring to each annual convention a sufficient number of sketches of an idea or device to supply all other members who were prepared to exchange. Sherman worked hard in creating a sentiment in favor of this scheme, and for a number of years it was practiced quite successfully. But a few years bring many changes. A large proportion of the old membership drops out of sight, and a constantly increasing number of new individuals join the ranks. The idea did not appeal with sufficient force to the newcomers to induce them to continue the work. It therefore gradually dwindled. Finally there came a meeting at which very few sketches appeared, and the scheme was then dropped. If our membership only could realize what an im-

PLATE III.



GEORGE A. ELLIS,

President of the New England Water Works Association,
1884–1885.

mense amount of information could be imparted by this simple process, they would not have allowed the practice of Sherman's most excellent scheme to have faded completely out of sight.

No one present at this meeting will ever forget the wonderful hydraulic display which occurred while the morning session was being held in the parlor of the St. Charles Hotel. An unusually severe thunderstorm occurred, which broke up the meeting. Presently a horseless carriage appeared upon the street and passed the hotel. There was no driver to guide its course. It moved very like an automobile. It was propelled by the power of the violent wind and rain. Whence it came or whither it went we never knew. Neither can we forget the good-natured bantering which occurred later in the day at Tyng's Island, between Col. A. A. Hagget, of Lowell, and Charles F. Chickering, of Pawtucket, R. I. And also we remember our worthy member who lost his hat, and his frantic attempts to regain the same, directly in front of Mayor Donovan, who then was addressing the convention in the dining-room of the St. Charles Hotel. Among the new faces which appeared at this meeting were those of George E. Batchelder and Lucian A. Taylor, both of Worcester.

At this convention George A. Ellis, then city engineer and water registrar of Springfield, was elected President. Mr. Ellis had secured an excellent reputation throughout the country by reason of his original work in hydraulic investigation. You are all familiar with his little book relating to the flow of water in pipes and fire streams. It then had been recently published. He was very prominent in our affairs during the period of which I now am writing. Shortly after, his professional work called him to a distant part of the country, and we were the losers thereby. At the same meeting Albert S. Glover, then water registrar of Newton, superseded the writer as Secretary. With these two able pilots at the helm, the Association made a rapid advance, and the next year occurred the most brilliant social event which this society has ever witnessed.

During the following fall the Association was entertained by the city of Newton, with sightseeing during the day and a banquet at Hotel Vendome, Boston, in the evening.

The following year occurred the joint meeting of this Association with the American Water Works Association, which held its annual session at Young's Hotel, Boston, in April, 1885. Previously a committee had been appointed to arrange a program of entertain-

ment for the visiting delegates of the American Association. The members of this committee were, Frank E. Hall, chairman; Albert S. Glover, secretary; J. Henry Brown; A. H. Howland; Albert F. Noyes; Wilbur D. Fiske; Jason Giles, and Charles H. Baldwin. While each member should receive a full share of the credit due the committee, I wish to make special mention of two of these names, because the committee was saved the embarrassment of planning in the dark by reason of their personal guarantee to raise the financial means necessary for the execution of the scheme. I refer to Jason Giles, who was the manager of the Chapman Valve Manufacturing Company, and Wilbur D. Fiske, who was agent for the George F. Blake Pump Company. Both were greatly interested in the welfare of the Association in those days, and did much personal work in promoting its interests. Fiske was a great joker. He possessed a most vigorous activity, and was always sure to have a crowd around him. Unusual demonstrations of merriment could always be heard when he appeared upon the scene.

The committee succeeded in collecting a fund of nearly twenty-five hundred dollars, all of which was expended in the execution of a well-planned program of entertainment. I don't ever remember passing a week in which every detail of a printed schedule was better executed. It was a continuous succession of festivities, and I remember that one of our best-known members afterwards told me that for two weeks after the close of the convention he had difficulty in keeping awake all day. It certainly was a most enjoyable week for all of us, and I think it was equally so for the visitors whom we entertained. Colonel Gardiner, of New Orleans, was the president of the American Association at this time, and J. H. Decker was secretary. They were very happy men during that week, and so were all of us. At the close of the convention Peter Milne, of Brooklyn, succeeded Gardiner as president of the American Association. Later he became secretary, which position he held until his death a few months ago.

The visiting delegates to the convention came as strangers to most of us. They returned to their homes with a host of new friends, and there are many strong ties of friendship to-day which date their origin from the time of this gathering.

The entertainment program included visits to places of interest, sometimes two or more parties going in different directions, and all in perfect harmony. The star event of the occasion, however, was the

PLATE IV.

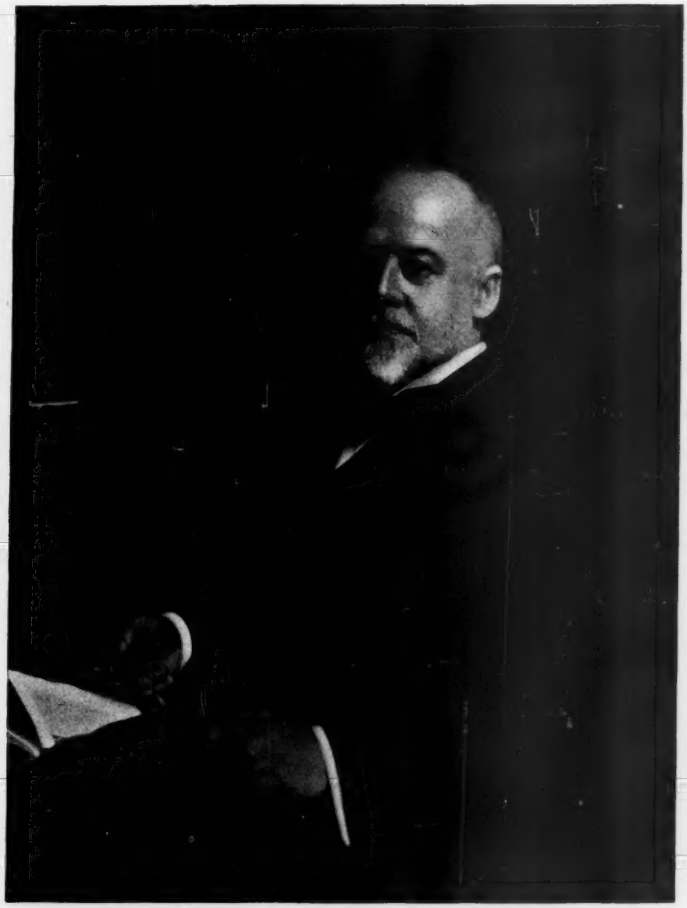


Photo. 1902.

ROBERT C. P. COGGESHALL,

President of the New England Water Works Association,
1885–1886.

"Duty Test of the American Water Works Association by the New England Water Works Association." It seems that Colonel Gardiner had asked in open convention in a previous year, "What is perfect duty?" referring, of course, to pumping engines. This test was in answer to his question, but on rather different lines from those to which his inquiry had been directed. If any pump had been necessary upon that occasion it would have been a stomach pump, for cases in which Nature had failed to perform her functions.

The menu was printed in an elaborate portfolio containing many technical phrases used during boiler tests, and illustrated with humorous sketches. The frontispiece of the menu was adorned with the motto, "'What is perfect duty?' L. H. Gardiner." I believe that the conclusion reached by this duty trial was that it consisted in attending to business, as exemplified by the illustrations on one side of the menu, and in not forgetting the good things of life as shown upon the remaining pages.

This elaborate function was held at Young's Hotel on the evening of April 21, 1885. It was elaborate in every sense of the word. The food, music, flowers, and the speaking which followed were all of superior quality. It was long after midnight when the benediction was pronounced. Quite a number of us had adjoining rooms which opened into each other. Of course we had to talk the event all over. About this time Fiske appeared with two colored individuals carrying pails containing liquid refreshments packed in ice. He was accompanied by another member, who proceeded to give us an astonishing dissertation on pipe laying. How we laughed! He was very lengthy, and we were both glad and frightened when he finished and left us, — glad that the end had come, and frightened at the way in which he went down stairs. As Fiske afterwards expressed it, the sound was similar to that caused by a large safe sliding down stairs and striking the floor below.

Glover had arranged to secure a fine report of that "Duty Test" banquet. You can imagine his consternation a few days later when he found that the reporter had lost every scrap of his notes concerning the event. Glover then went to work. He collected every newspaper report obtainable, and then with the aid of different memories the report was written as it now appears in the transactions of 1885. This episode, however, proved to be a blessing in disguise. More care was hereafter exercised in the selection of a reporter. This resulted in the discovery of Mr. James P. Bacon,

who sits before me, and who from that day to this has been constant in our service. His work, to say the least, has always been extremely satisfactory. A meeting of the Association would hardly seem complete without his presence.

In the long list of candidates who were elected members at this time the following names appear: William F. Codd, Dexter Brackett, Willard Kent, Wilbur F. Learned, F. H. Parker, and George A. Stacy.

Two months later (June, 1885) the fourth annual convention was held at Springfield, Mass. The writer succeeded George A. Ellis as President, and Albert S. Glover continued as Secretary. At this meeting Albert F. Noyes presented an elaborate paper on cast-iron pipe, and a lively discussion followed. This subject has been a perennial source of discussion from that day to this. The same may be said concerning "Service Pipe." Whenever short of material for our programs the introduction of either of these topics has been sure to provoke interesting debate.

At this same convention Mr. Billings and the writer presented a plan to secure uniformity in the presentation of the annual reports. This is another topic which has attracted considerable attention ever since.

Other papers presented were: "Relating to the Use of Tanks in Supplying Water-closets and Hot-water Boilers," by William R. Billings, and "Flushing Street Mains," by J. Henry Brown.

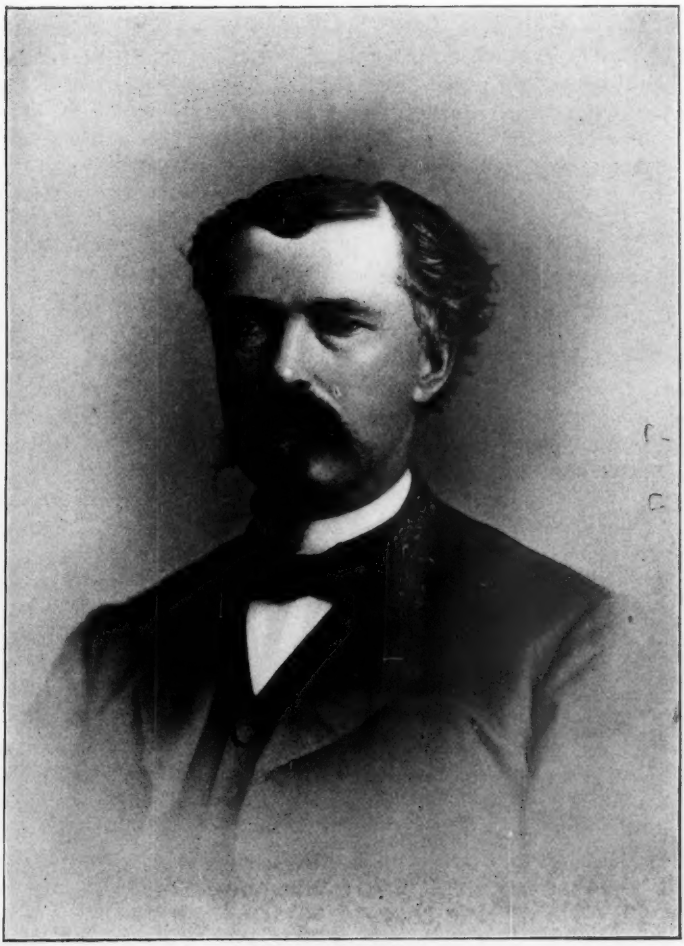
The most important act which occurred during the writer's administration was the development of the plan of the quarterly JOURNAL in its present form. It was Glover who conceived the idea, and I well remember when he first unfolded his plan and displayed figures to show that financially the scheme could be made a success.

The materialization of the plan for the publication of the JOURNAL required certain changes in the Constitution. This matter was referred to a committee who reported to the New Bedford convention in June, 1886, when the suggested changes were adopted. The positions of Senior and Junior Editors were created, and an increase in revenue was provided for by reëstablishing the status of the associate membership.

The first number of the JOURNAL appeared in September, 1886, and contained the proceedings of the New Bedford convention. It has continued to appear regularly each quarter up to the present time.

At the New Bedford convention more new faces appeared. There

PLATE V.



HENRY W. ROGERS,

President of the New England Water Works Association,
1886–1887.

were Patrick Kieran, Frank L. Fuller, Joseph E. Beals, M. M. Tidd, Phineas Ball, and William M. Hawes. The last three remain with us in memory only. Phineas Ball was a well-known pioneer water-works engineer, and a good one, too. He had been present at previous meetings, and now became a member of the Association. He had a genial and kindly nature, and made friends in every direction. I well remember the deep interest he took at that convention in the discussion which followed Desmond FitzGerald's excellent paper on "Rainfall." Mr. Ball and David B. Kempton, of my own city, were old friends (Mr. Kempton was a familiar figure at our conventions), and I used to enjoy hearing them rehearse former events.

M. M. Tidd you will remember as an accomplished engineer. He gave us all a great deal of inspiration and help. He had only one arm, and yet he was one of the best draftsmen I ever met.

William M. Hawes was the wit of the Association for many years. He was ready to discuss any question which came up. What a happy, jolly individual he was, and what faculty he possessed for putting every one about him in a good humor. How we sympathized with him in his long, painful illness, and when the end came we mourned his loss. When he made his bow to the Association at New Bedford, water meters were under discussion. He said that the perfect meter had not been invented; that he thought it would be like the perfect man, — just as he gets perfect he up and dies. The millenium will come with the perfect meter, and then we will have no use for it. He closed his remarks with the recital of a humorous poetical confession of a wicked water meter, which convulsed the whole audience.

At this convention, in addition to FitzGerald's "Rainfall" paper, George A. Ellis contributed a paper on "Discharge of Mains as Determined by Pressure Gages." Col. J. T. Fanning presented a paper on "Pumping Machinery," and Dexter Brackett, one on "Wastes of Water." Besides these there were many topical discussions.

The Association had its headquarters at the Parker House in New Bedford. After the evening session of the second day the rooms were filled by a crowd which was in no hurry to woo the sleepy god. A number being of a musical turn of mind took to singing the popular songs of the day. Perhaps to outsiders it sounded more noisy than musical. Anyhow it disturbed some of the inmates of the house, one of whom got up and sought the aid of a police officer

whom he found outside, surveying the windows from whence the sound issued. The disturbed lodger urged the officer to go in and stop what he termed an unmitigated nuisance.

"No, you don't," replied the officer, "I know my business. The mayor's in there."

The next day, upon the excursion boat, in passing down the bay you could have heard Fiske pointing out the old Revolutionary Fort Phœnix to the crowd, and endeavoring to convince them that it was there that Ethan Allen demanded the surrender in the name of the great Jehovah and the Continental Congress. Upon a protest being made by a member from Vermont to the effect that the event described had occurred near his home, Fiske replied, "Well, I'll postpone the rest of this story and continue it when we have a convention in Vermont."

At the closing session of the New Bedford convention, Henry W. Rogers became President, Albert S. Glover continued as Secretary, and William R. Billings and the writer assumed the duties of editors of the first issues of the JOURNAL.

The next year (1887) the annual convention was held at Manchester, N. H., at which place I resumed my former position as Secretary, which office I continued to fill until January, 1895. During this period the annual conventions were held in the following places: —

1888, Providence, R. I.
1889, Fall River, Mass.
1890, Portland, Me.
1891, Hartford, Conn.
1892, Holyoke, Mass.
1893, Worcester, Mass.
1894, Boston, Mass.

The Presidents with whom I served were: —

1887–88, Edwin Darling.
1888–89, Hiram Nevons.
1889–90, Dexter Brackett.
1890–91, Albert F. Noyes.
1891–92, Horace G. Holden.
1892–93, George F. Chace.
1893–94, George E. Batchelder.
1894–95, George A. Stacy.

The Senior Editors of the JOURNAL with whom I was associated were: —

Prof. George F. Swain, two years.
Desmond FitzGerald, one year.
F. H. Parker, one year.
Dexter Brackett, four years.

The Junior Editors were : —

William R. Billings, two years.
Albert S. Glover, two years.
Walter H. Richards, five years.

Brackett, Richards, Glover, and Billings all did an immense amount of detail work, and the Association profited by their conscientious efforts.

This Association had published over one hundred and fifty important papers up to the time I resigned the secretaryship in 1895. There had also been more than that number of topical discussions.

With the New Bedford convention, in 1886, I close this series of reminiscences. Many members of prominent standing, familiar to you all, have not been mentioned in this paper simply because their connection with the Association dates from a later period. The list is a very long one, and cannot with justice be lightly entered upon in a brief survey; so it appears better to refrain from any attempt at this time. There are those who have done what they could, and done it well, and the Association has been a gainer thereby. Proper credit should and will be ascribed to them in a future review of the period of time in which they worked.

One word regarding the JOURNAL. In 1893 a full index of all our previous publications was published. This was the work of Henry N. Ogden, C. E., and Dexter Brackett. It has occurred to me that the revision of that index up to and including the volume now in publication would be a production which would be appreciated by the frequent readers of our society publications.

I have heard the charge made that our Association has become more of an engineering club than a water works association, and that technical productions outweigh the practical. Is there any foundation for this statement? I think not; for I am not aware that the needs of the practical worker have ever been overlooked. That a larger number of practical papers would be acceptable goes without saying; but it is exceedingly difficult to induce the average practical worker to relate his experience. He likes to listen and absorb, but dislikes to talk; while on the other hand it is compara-

tively easy to secure the production of the well-trained student. This is the reason why it is difficult to always obtain a proper balance for an ideal program. We will all agree that the interests of the practical worker should be jealously guarded. He should be supplied with plenty of material each year. But the progressive worker cannot and will not stand still. You never knew a broad-minded practical worker of limited education but that he regretted his lack of technical training. Such a man is bound to press forward. He will absorb all he can, and the time soon arrives when his thoughts pass from elementary stages to more profound considerations.

Papers are occasionally presented the technical portion of which is too abstruse to secure the appreciation of the majority of our attendants. While such papers have their proper mission, it is better in the interest of best results that the speaker confine his remarks to limits within the range of all his listeners. We are very fortunate in having in our membership a few who rank high in their special work. They are constantly delving in pursuit of nature's secrets; and when rewarded by success in their undertakings, they come here and tell us about it in language so simple that every listener comprehends the truth that is uttered. No one ever complained that he could not understand every word of Prof. William T. Sedgwick's admirable addresses to this Association; and he always secures the delighted attention of the practical worker. The scientist that follows this plan is the true educator, and makes an ideal member of such a society as this. He interests the practical worker, and is sure to unconsciously influence his future thoughts. The worker in turn gladly aids him to new observations and the securing of data for new investigation. By such a process as this, the ideas of the worker will constantly aspire to higher standards.

In conclusion, the question may be asked, After twenty years, what? I think we can point with pride to the monument of literature which the members of this Association have gradually erected during these past twenty years. There it stands upon your shelves in almost as many volumes. No question is likely to arise in the practice of any official but that information pertaining to the same does not appear somewhere in its pages. Those volumes are among the best of reference books which every superintendent should have before him in his daily work. It needs no further encomiums. The work of its preparation has been done in the past by faithful and willing hands, and I am sure this will continue.

In considering the future of our Association from the present point of view, we see a well-equipped headquarters in Boston; the financial aspect in healthy condition; the absence of all jarring discord, and an interested membership who attend our meetings. As long as this condition continues it does not appear worth while to entertain any concern regarding what the future may have in store.

APPORTIONMENT OF CHARGES FOR PRIVATE FIRE PROTECTION AND THE MEANS OF CONTROLLING THE SUPPLY THERETO.

[*Reports of Committee and Discussion, September 11, 1902.*]

F. H. CRANDALL, C. K. WALKER, J. C. HAMMOND, JR., B. I. COOK, E. V. FRENCH, H. A. FISKE, AND JOHN C. CHASE, *Committee.*

The President called on Mr. Crandall for the Committee's report.

MR. F. H. CRANDALL.* As was understood when this Committee was appointed, Mr. President, some of its members held diametrically opposed views in regard to at least two of the matters involved, namely: First, as to who should pay the cost of private fire protection, and, second, as to the question of limiting the sizes of services permitted. We are obliged to report to-day that we are unable to agree, and probably never will be able to agree, on these two points. Three members of the Committee, Mr. Walker, Mr. Hammond, and myself, submit the following statement: —

Report of Messrs. Crandall, Walker, and Hammond.

Three members of your Committee, to whom was referred the matter of apportionment of charges for fire protection and means of controlling the supply thereto, would respectfully report that we find the opportunities for taking water without the knowledge of the water department, afforded by the presence of private fire pipes, are frequently taken advantage of; that furnishing private fire protection merits compensation; that the compensation, however, should not be such as to discourage the use of automatic sprinkler systems; that securing assurance of the use of private fire pipes for such purposes only is a matter of small expense and may reasonably be required.

We would recommend that, provided trustworthy evidence in regard to the use of the service and reasonable remuneration for the protection afforded be furnished, such applications for private fire services as will not unwarrantably jeopardize other interests be granted.

MR. EDWARD V. FRENCH.† As Mr. Crandall says, our Committee have had different ideas, and we have not been able to agree even on two reports. We have had a most interesting dis-

* Superintendent of Water Works, Burlington, Vt.

† Inspector Associated Factory Mutual Insurance Co.'s, Boston, Mass.

cussion in the Committee, and those of us who differ from Mr. Crandall feel that he has gone just as far as he can in the matter with the view which he takes of the underlying principles of the whole thing, and we think he has shown a very excellent spirit in trying to get us together. I think if we had had more time, or, rather, if we had lived nearer each other so we could have had more frequent meetings, we could have agreed on some sort of a report; but, although we have had a great deal of correspondence, we have not succeeded in having meetings where we could all be present, except in one or two instances. I think we have never had a really full meeting, but we have discussed a good deal of matter which has been interesting, and I think we have all learned something; I am sure I have.

Our feeling was, then, that we could not do better, as long as we could not agree and as long as the matter had been deferred so many times, than to bring in our several ideas in the briefest form we could, and to say that in the most friendly spirit we had agreed to disagree and to put the facts before the convention and let the matter stand there. It may be that some further work can be done that will be of interest, and I think we are not very far apart now in the final result, our real difference coming in the fact that we feel that there is an underlying principle which gives a man a right to certain things, which Mr. Crandall and the other two gentlemen feel does not exist; and although the actual amount that Mr. Crandall wants to charge for the private fire service is small, and perhaps not appreciably larger than the user would be charged under the scheme that we have in mind, we felt that nothing was to be gained by covering up what seemed to us to be the elementary principles that underlie the whole thing, — questions of right and justice. And, as I say, our differences are wholly of a friendly nature and are wholly based on our different conceptions of the thing.

Now, we have put together a brief report which, if I may be allowed, I will read. This report is agreed to by Mr. Fiske, Mr. Cook, and myself. I think Mr. Chase will have something to say later which will show where he differs a little from all the rest of us. Our report is as follows: —

Report of Messrs. French, Cook, and Fiske.

Investigations and experiments made by your Committee have resulted in the following conclusions: —

First. Taking the country at large, water is taken somewhat frequently from private fire pipes for manufacturing and miscellaneous uses without the knowledge of the water departments.

The majority of such takings are not with deliberate intent to defraud the water department, but from a lax view of the rights in the case. Instances of intentional stealing, even to the extent of making concealed taps, are, however, not uncommon.

Second. Private fire protection is a benefit to the general public, because it greatly lessens the chances of a partial or total destruction of a prosperous manufacturing industry, which always means a loss of wages to operatives and sometimes a loss of the industry to the town. Further, fire allowed to gain headway in a large plant may spread and do great damage to surrounding property.

The effectiveness of private protection is largely due to the automatic sprinklers which cover every part, even to the most obscure corner, and stand ready night and day to put water on a fire the instant it starts.

Third. Water supply systems are almost universally laid out to furnish water for extinguishing fires as well as for domestic and manufacturing uses. A manufacturing concern, therefore, has a right to water without charge for extinguishing fires, the same as any other taxpayer. If then, the manufacturing concern puts in protection and desires to use public water in this private system for fire purposes because the public water can be used more effectively in this way, it is usually reasonable and right to allow it, providing absolute assurance is secured that water is not used for any other purpose. To allow this entails no extra cost to the public whatever, and absolutely lessens the calls which a plant makes on fire and water departments.

Fourth. Plants having private fire protection should pay all cost for such equipment, all the first cost for connecting to the public mains, and a yearly charge, ample to reimburse the public water department for all reasonable supervision of their fire pipes, such as to read and keep in repair any detecting devices which may be provided, and any other similar expenses.

Where a protected plant desires a better water supply than that furnished to the average taxpayer, considering relative values, it is right and proper that a part, if not all, of the cost of the additional mains needed should be paid for by the protected risk, the conditions in each case determining what is just.

Fifth. There are at present a number of ways by which assurance can be secured that private fire pipes are used for fire purposes only. It is considered that this branch of the investigation could be extended to advantage. The following methods have been examined with results as given: —

(*a*) Ordinary meters are not satisfactory from the possibility in many types of serious obstruction to the flow and from the fact that large size meters are frequently not sufficiently sensitive to detect the smaller drafts.

(*b*) Hydrants, sprinkler valves, and all other outlets of the fire system may be sealed, and a penalty provided for a broken seal which cannot be satisfactorily explained. Such sealing gives considerable protection, but is not positive guard against the unscrupulous taker, and it requires regular supervision on the part of the water department. The general extension of sealing throughout fire systems would be considered rather undesirable by the underwriters, from the tendency it has to take the responsibility for the private fire apparatus away from the mill people, thus encouraging them to rely more and more on the public department, where experience is believed to indicate that a good private fire brigade is always desirable in a large manufacturing property.

(*c*) A $\frac{5}{8}$-inch by-pass may be provided around the main gate where the fire service enters property having private protection. A water-works official can quickly slip a meter into this connection, shut the main gate without

notice, and thus instantly detect a flow of water. This method gives no constant watch, but, in some cases where conditions will permit, may give the water-works superintendent all the means he needs to feel reasonably sure as to the use of private fire pipes.

(*d*) Proportional meters consisting of a weighted check valve with a small meter in a by-pass around it can detect very small flows, and will give good results where the fire services are used for fire purposes only, and where any other use which the detector may indicate may be considered a violation of the contract, resulting in a penalty. This device, it is believed, has possibilities of further development into a more convenient and serviceable piece of apparatus.

(*e*) Various other special devices and inventions have been partially considered, but need more study before a report of value can be made.

Sixth. Data as to the layout, use, value, and cost of private fire protection were suggested by the questions submitted to the Committee. The following facts are presented:—

(*a*) Extensive private fire systems are laid out by the engineering departments of insurance associations.

(*b*) The simplest arrangement of piping is always desired.

(*c*) The general custom is to absolutely separate the fire pipes from those supplying water for manufacturing and similar purposes.

(*d*) Outside gates with indicator posts are provided on connections going inside of buildings, to permit shutting off water in case of breaks.

(*e*) The requirements of the water department as to the plans of private piping, uses of water, notice of tests, etc., should always be strictly followed by the protected risk.

(*f*) A yearly test of the capacity of public water, to ensure that all is in good condition, gates open wide, etc., is usually desired by the underwriters.

(*g*) Private protection usually costs the owners from three to five per cent. of the total value of the property which could be destroyed by fire. A $300 000 plant, therefore, requires from $9 000 to $15 000 for full equipment.

(*h*) From $100 000 000 to $200 000 000 is annually destroyed by fire in the United States, and private protection is the best means of reducing this loss.

(*i*) Records for the year 1900 from a group of protected risks manufacturing cotton and woolen goods, paper, and general metal work, with an aggregate value of $900 000 000, show that only 450 fires were reported with a total loss of $555 000. Three hundred and seventy-nine of these fires caused a loss less than $1 000 each; 59 less than $10 000, and 12 a loss of over $10 000. In the case of the 12, the large loss was due to some deficiency in protection or some accident.

We suggest that a committee be appointed to continue the subject and investigate means whereby assurance may be had that private fire pipes are used for fire purposes only, and report to the Association at some future meeting. We also suggest that such committee be requested to confer with the American Water Works Association, the National Fire Protection Association, and any other similar organization which may desire to coöperate on this subject, in order that the experience of all may be obtained and that any further action may be uniform and harmonious.

SEPTEMBER 11, 1902.

MR. WASHINGTON PAULISON.* I move, Mr. President, that Mr. Crandall's report be received and approved by the Convention.

MR. FRENCH. I think Mr. Chase ought to be heard from before we take any action.

*Superintendent of Water Works, Passaic, N. J.

THE PRESIDENT. We should be glad to hear from Mr. Chase as a member of the Committee.

MR. JOHN C. CHASE.* Mr. President, I find myself in the rather unenviable position of not being able to agree upon all points with my esteemed associates on either side of the fence, but I do not know that my position is much worse than that in which a distinguished justice of the United States Supreme Court found himself in regard to the insular decisions, which some of you may have heard spoken about more or less last winter. On the fundamental proposition I do not differ materially from that held by the water-works members of the Committee, and I am not able to endorse all the views of the other members; but I have very briefly reduced to writing what I have to say, and it is as follows: —

Report of Mr. Chase.

It appears to be beyond question that there is a gross misuse of fire service systems, but it is only fair to assume that in many cases the unlawful use is due to a low standard of morality in regard to corporate rights in water rather than wilful larceny.

The municipality having assumed the responsibility of providing a water supply for fire protection, the expense of the same being uniformly distributed by taxation among those benefited, I hold that those who, at their own expense, equip their establishments with additional means for the more effective prevention or suppression of fires should not be subjected to any charge, except what may be required to cover the expense of the supervision needed to make certain that no unlawful use of the equipment is made. I do not consider that the benefit derived by the consumer in the way of decreased insurance premiums, or the indirect gain to the community by preventing a fire has anything to do with the question at issue. The generally understood custom credited to railroad corporations of "putting on all that the traffic will bear" should have no place in water department management.

I believe that all expense of connections and necessary indicating devices to insure that no improper use is made of the fire service pipes should be borne by the consumer, also any changes in the street mains made necessary by the requirements of the system to be installed. The unlawful use of the pipe system should be punished by a deprivation of its benefits.

THE PRESIDENT. Gentlemen, this report has come before the Association in a very interesting form, and it is now before you for your discussion and action. I trust it will receive careful consideration at your hands. We should be glad to hear from Mr. Paulison now.

MR. PAULISON. We have furnished water to manufacturers to be used only for the extinguishment of fires, and we have relied upon

* Civil Engineer, Derry, N. H.

them to use it for that purpose and that only; but we have found in many cases that they used it for other purposes. We have put on meters and we have found that they worked satisfactorily. Now, inasmuch as we charge the city for hydrants, I don't understand why we should allow manufacturers to have them for nothing. On the contrary, as they receive a benefit from them, and as the water company is in the market and doing business to make profit, I can't see why the manufacturers should not pay.

MR. ALLEN HAZEN.* Mr. President, it seems to me that the evil of stealing water from city pipes is a very serious one. I know about these matters only occasionally and incidentally, but the frequency with which I have come across cases where manufacturers were drawing large quantities of water from pipes put in for fire purposes only indicates to me that it is a pretty prevalent vice, and I think that something ought to be done to check it. Just the best way of getting at it, I don't know. Mr. French's suggestion rather appeals to me, and I should like to see all these reports accepted, and a committee from this Association, acting with committees from other associations, take the matter up and see what means can be devised for making sure that pipes for private fire purposes are not used for other purposes.

Just as illustration of what may happen, I was in a small city a few weeks ago with Mr. Connet, to see what we could find out as to where a very large quantity of water was going. A Venturi meter was put on the supply, — Mr. Connet operated it, — the reservoir was cut out, and we pumped directly into the mains. The city was divided up into sections, each supplied through one gate, and those I had closed in rotation while Mr. Connet noted the record of the Venturi meter. In that way we found where the bulk of the water was going, and then followed it up. We found, for instance, that one mill which had a 6-inch pipe connected with the sprinkler system, and supposed to be connected with nothing else, — the mill was not paying a cent for water, — was drawing as much water as it was possible to get through a 6-inch pipe under a pretty fair head, something like four or five hundred thousand gallons per day. There were a few other mills which were n't drawing so much, but the water which was taken in that way formed a very considerable percentage of the total amount of water which was being supplied in the town. Now, I don't know what the best way to get at this may be, but

*Civil Engineer, New York, N. Y.

it certainly is a very serious evil, and an evil large enough to require very radical means for its treatment.

MR. W. C. HAWLEY.* I notice the extreme delicacy of the gentlemen of the Committee about using the plain Anglo-Saxon word "steal" in connection with this matter. I can't understand it, unless it be on the principle upon which a case, which I heard of at one time, was decided, where a private company arrested an individual for stealing water, — that was the charge. The justice of the peace before whom the case was tried discharged the man on the ground that "water is free," and therefore could not be stolen. [Laughter.] I do not see why when that which represents capital, money value, is appropriated by one to whom it does not belong it is not stealing, and I think we make a mistake when we attempt to cover it over by using a smooth, easy word. Every water-works official knows that water is stolen, and that many times it is stolen in large quantities. One of the largest water-works companies in this country was very nearly wrecked financially a few years ago by the deliberate stealing of water which went on for months. In spite of the vigilance of the superintendent of the company, and repeated efforts to locate the leak, which happened to be on a branch from the force main very near the pumping station, they were unable to find it until the company had been forced to make a large expenditure for an additional supply.

In regard to a method of furnishing a fire supply independent from the supply for manufacturing purposes, and doing it in such a way that the stealing of water can be detected, I found near Pittsburgh a very successful method in use, one which I believe is approved by the underwriters, and which is very satisfactory both to the manufacturing concern and to the water company. It was installed by my predecessor, Mr. W. A. Alexander, and was described by him at the Chicago meeting of the American Water Works Association last spring. A 12-inch main runs in, supplying water for manufacturing purposes. Parallel with that is another 12-inch main to supply the water for fire protection. A valve on this 12-inch fire line is operated by hydraulic pressure, — an hydraulic valve, — and is ordinarily closed. At one or more places through the plant there are connections from the ordinary service line to a pipe running to the cylinder on this hydraulic valve, and in case of a fire the turning of the cock opens that valve within a few seconds,

* Engineer and Superintendent Pennsylvania Water Co., Wilkinsburg, Pa.

and turns on the whole pressure for fire service. In order to detect the possible taking of water from this service, except for fire protection, a three-eighths inch meter has been connected to the fire line, discharging to a drain, so that whenever pressure is on this line the meter registers. The valve is tested at least once a week, and the tell-tale meter is read at the same time that the meter which is on the regular supply line is read, every day, so we can detect at once if any considerable quantity of water is taken from the fire line.

THE PRESIDENT. If Mr. Kimball, of Knoxville, Tenn., is in the room, we should be glad to hear from him.

MR. FRANK C. KIMBALL.* The report of the Committee deals with practically two distinct subjects: One, the apportionment of charges for private fire protection, and the other the means of controlling the supply. Now, as regards the apportionment of charges for fire protection, there is, of course, a varied opinion, and the Committee seems to be divided on that more than they are on the other.

In a municipally controlled plant, it may be a question whether any charge should be made or not. That should be governed more, perhaps, by the way in which they keep their accounts, — whether they charge for hydrant service and fire protection, or, as was very pertinently stated yesterday, whether it all was charged up to the consumer. In a privately owned plant, such as I represent, there seems to be no question but what some charge should be made; there may be a question as to what that charge should be.

In our plant we have a charge, but that charge is graded or arranged in such a way that if our customer for fire protection is also a customer to a certain amount for water for other purposes, we give him his fire protection free of charge. That, I think, covers the case as raised by Mr. French. In other words, we are in business, of course, for what there is in it, but at the same time we are ready to protect our own customers. Those who are not our customers to any further extent than for fire protection we expect to pay for it.

Regarding the means for controlling the supply to manufacturers, mills, and other establishments, I think there is no difference at all, as near as I can find out, among the members of the Committee, that some means should be taken to control the supply. All men who have had any experience with water works, I think, will agree with me in saying that sooner or later, in some place or other, they have

* Superintendent of Water Works, Knoxville, Tenn.

run across cases of stealing, if you choose to use the word; although I am firmly convinced from my experience that a large number of the cases of the surreptitious use of water are without the consent or the connivance of the owners of the property themselves. In the South especially, more than in the North, pipes are laid underground more because there are few basements even to mills or manufacturing buildings, and it is the easiest thing in the world for an engineer who wants a supply of water at some part of his plant to shut a gate controlling the main supply, — they all have to be gated, of course, to conform to the underwriters' requirements, — make a tap dry, and run his supply pipe wherever he chooses underground; and I have yet to discover any adequate means of inspection which will take care of a pipe of that kind.

We have had some difficulty in our place on just this point, and two or three years ago we adopted a method of handling fire supplies, which was against their wish somewhat, I will admit, but has met the approval of the underwriters in that section, — possibly because they found they could not get a fire protection supply without it. [Laughter.] It is something that to my mind seems to overcome the objections that have heretofore been raised against metering fire protection supplies. We have no fire protection service larger than a 6-inch, and those we treat in this manner: A main line of 6-inch pipe is run into the premises, with a gate and indicator post on it as required, and around this gate is a by-pass of the same size as the pipe, 6-inch, on which, protected on one side by a valve and on the other by a check valve, a 6-inch meter is placed. (See Fig. 1.) This gives the full capacity of the pipe, and it also gives an opportunity to open this 6-inch gate in the main line, which ordinarily is kept closed and sealed, so as to give an additional supply, or give the supply that the meter may not give in case of fire; and at the same time the meter is of such a size that at the breaking out of a fire it will give practically all the water that is needed, and nearly as much as the main pipe itself will furnish. We then have the regular supply for the mill taken off inside of this gate and meter, so that the water used ordinarily passes through and is registered by this meter. That keeps the meter working, and it does away with the objection which is frequently raised that a meter on a fire line, not having any work to do, sticks and can't be used when it is wanted. It is inspected regularly once a month by the water company. Another thing which helps is that, according to the regulations of our company, a man in

our employ answers every alarm of fire, and it is his especial duty to look out for all gates on the line, such as this and others, and to see that the supply is all right. Until some arrangement is devised such as Mr. French mentions, as of a weighted check-valve or some other contrivance whereby the gate, which, for the protection of the company must ordinarily be kept closed, can be opened automatically, it seems to me as though this system which we have is about as good as anything.

In reply to a criticism which is made that a 6-inch meter will not register a small enough stream to account for all water that is used

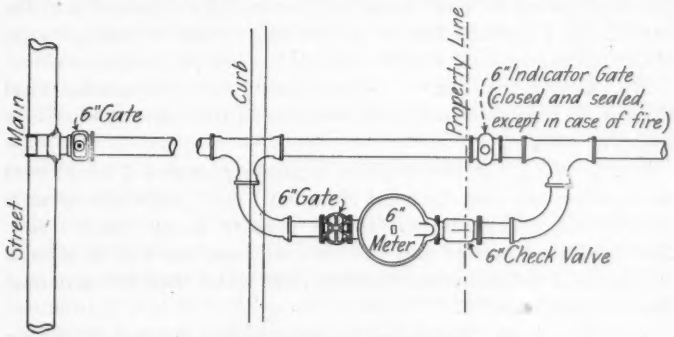


FIG. 1.

for ordinary purposes, I will state that the meters we use when tested before they have been placed have registered over ninety per cent. of an eighth of an inch stream, and over ninety-eight per cent. of a quarter of an inch stream, under thirty-five to forty pounds pressure, and if a manufacturer is using sufficient water to get fire protection free of charge the flow is sufficient so that there is practically, as meters go, no loss by lack of registration.

This plan that we have, I think, is at the present time the best that I have ever seen. It answers the purpose; it gives good protec-

tion; it is almost automatic, and it does away with just that thing that we are all troubled with, — the stealing or surreptitious use of water. That is one of the greatest evils, I think, that we have to contend with to-day.

I will say further, for it may be of interest to some members of the Association, that one manufacturer in our town rather objected to the arrangement, and was backed up by the underwriters who refused to accept the meter that we proposed to put on the pipe, although we were ready to demonstrate to him that under the system as we installed it we could furnish through that meter something over one thousand gallons of water a minute. He has taken the case into the courts, and I presume that if we live long enough we can get a judicial determination of whether that system is a proper one or not.

MR. KENNETH ALLEN.* I should like to ask the speaker what the general type of meter is that he uses on that service, whether a rotary or disc.

MR. KIMBALL. It is a positive registering meter. I would have no objection to giving the name of it, but I don't think it is exactly my business to advertise it. It is a positive acting rotary meter. And I will say further that the tests we have made of it show it is capable of delivering considerably more water than the manufacturer's limitation of it.

THE PRESIDENT. Mr. Hammond, who started the ball rolling on this subject and has taken a great deal of interest in it, I am sure can say something to us at this time which will be of benefit to us, and I will ask him to address us.

MR. J. C. HAMMOND, JR.† Mr. President, I hoped to be able to keep still to-day, and I guess should have if you had let me alone. Mr. Crandall is our chairman, and I would most certainly like to hear from him, and then I may have something to say later. I am sorry our Committee could not agree entirely, although we did agree on one thing; that is, we all endorsed the commandment, "Thou shalt not steal." Now, when a man comes to us and wants us to lay a main pipe through a street where he has some building lots to sell, what do we say to him? We say, "We can't lay that pipe until you guarantee us a fair return." A man has a pipe put into his house and then goes off to the seashore for two months, and during that time does n't use any of our water, but still he has to pay for

* Engineer and Superintendent of Water Works, Atlantic City, N. J.
† Treasurer Water Co., Rockville, Conn.

it just the same. Some of us are staying at this hotel at four dollars a day, and suppose we happened to be invited out by some meter man to dinner, and we did n't want to pay for our dinner here because we had had it somewhere else. The hotel people would say to us, "Why, we had dinner ready for you here, and if you did n't eat it, it was n't our fault; you must settle just the same." Now, that is all there is about it. We have put our money into water works and we have water for sale, and a man can use it if he wants to. The manufacturer has this advantage, that if he uses a large quantity of water he gets a lower rate for it than a man who only uses a little. We put in a pipe for him for fire protection, which enables him to make a large saving in his insurance, and then he does n't want to pay us anything. They say that water is free and that air is free, but that is n't always so. You go down into the basement of this hotel and you will see some blowers, which make the air here very nice for us to breathe, and we say that air is free. But who furnishes the power and pays for running those blowers? [Laughter and applause.]

MR. KIMBALL. If I may be permitted to say another word or two, in our town we have a condition of things which perhaps does not prevail everywhere. Our water is filtered, and there is absolutely no sediment in it as it is delivered to the consumer; consequently the danger of a meter clogging and thus being out of use at just the time when it is wanted does not exist, as it might in some other places where the water as delivered in its natural state contains more or less sediment and, as some of us have known, eels at times. Now it seems to me that the suggestion which was made to refer this whole question to a committee of the Association to act, if it can be done, in conjunction with a committee of the American Association and of the boards of underwriters, to formulate, perhaps not one but two or three or four plans or sets of suggestions whereby this matter may be handled without friction between the water companies and the insurance companies, is an excellent one.

The American Association at its meeting last June, after a report by a committee, passed a series of votes which, if followed out, would compel the placing of meters on all fire protection lines. While I firmly believe that that is a solution of the problem, still there are objections, as I know from personal experience, on the part of the underwriters against such a plan. I think, however, that a plan can be evolved, if all parties will go at the matter in the right

manner and in the proper spirit, which will be acceptable to all and will really be of advantage to the manufacturer. I have yet to find a manufacturer who is not willing to conform to the water company's rules if they are backed up by the underwriters' rules, or to the underwriters' rules if they are backed up by the water company. But as it is now he is between two fires, and he is going to protect himself if he can. If the various interests — the water companies, the public water departments, and the underwriters — can get together and formulate rules under which they will work in harmony and unison, I think this whole question will be settled, but I don't believe it will be settled until they do.

THE PRESIDENT. We should be glad to hear from Mr. Crandall.

MR. CRANDALL. I do not know, Mr. President, that I can add anything to what has been said on this subject. As far as I am personally concerned, my difference with the underwriters and with the insurance people is solely confined to the two points that were mentioned. I believe that the class of people who are wealthy enough to have private fire protection are not for that reason, simply because they are wealthy, entitled to get this better protection at the same price that a poorer protection is afforded to the average taxpayer. I also believe, and my experience has been such as to make it very apparent to me, that injury to others is liable to result from the presence of unnecessarily large services for fire protection, or too large services for any purpose. I do not want any larger service put into my house than is necessary to supply my needs, for an accident to it might cost me money. And when it comes to putting in such services as are now demanded for private fire protection and for elevators and for some other purposes, there is, I think any one but an insurance man would admit, danger to other interests — and I do not mean any disrespect to the insurance men. [Laughter.]

It may, perhaps, be interesting to members of the Association to know that in Burlington for a number of years past the fire protection of the entire city has been dependent upon the automatic action of a device for passing water around our high-service motor, about which you have all heard. This device acts from once a month to forty times a day, as the requirements may demand, and we have yet to experience any trouble on account of its failure to operate. Before the present device was in use, before our needs became such as they now are for large quantities of water in a short space of time, we had a similar arrangement of a check valve instead of a

butterfly valve, as we now use. That arrangement has been in use for twenty-two years, and the supply was never impaired on account of the failure of this automatic opening.

Reference has been made to the report of a committee of the American Water Works Association at the last meeting of that association, and perhaps it would be of interest to you to hear the report of that committee. I have the report here, and, if the President wishes, will read it.

THE PRESIDENT. I think it would be interesting to the members present to hear that report.

MR. CRANDALL (reading).

[*Report of Committee on Regulation and Control of Private Fire Service.*]

AUDITORIUM HOTEL, CHICAGO, June 13, 1902.

TO THE OFFICERS AND MEMBERS OF THE AMERICAN WATER WORKS ASSOCIATION:

Gentlemen, — Your Special Committee appointed to consider and report upon the question of the control and regulation of private fire service beg leave to report and recommend: —

That it be the sense of this Association, that the following regulations should be enforced: —

First. That all applications for attachments to street mains, for private fire service, be accompanied by a draft or plan of the proposed pipe system intended to be used on the property to be protected, together with a concise statement as to what other purpose the system might be used for.

Second. That upon approval of the application by the proper authority, its construction shall be such as to insure an accounting of all water used. Meters for this purpose to be installed and used.

Third. That by reason of the additional protection received by the property owner and because of the risk entailed upon other portions of the supply lines in case of a fire, it is eminently fair and just that there be made an equitable charge for every private fire service.

Fourth. That the objection of fire insurance companies to the use of water meters on private fire service attachments is not well founded, and should be opposed by the managers of water-works systems.

Fifth. That all expenses incidental to the installation of private fire service attachments, including cost of meters, be borne by the applicant or owner of the property.

Sixth. That the size of the openings for attachments shall be such as the engineer or superintendent shall find adequate, keeping in view, when deciding the question, the requirements necessary to properly protect other property on the same supply lines.

That to avoid surreptitious use of the water, devices be adopted by the superintendent and engineer to detect same, and in this connection we call attention to that of Mr. Alexander, of Wilkinsburg, Pa., as an example, and of which we will present a plan to the Association.

GEO. H. FELIX, *Chairman*,
C. E. BOLLING,
C. H. CAMPBELL,
Committee.

The device of Mr. Alexander is the one which Mr. Hawley described a little while ago.

MR. CHARLES K. WALKER.* Could I have a chance to say one word?

THE PRESIDENT. I was going to say that this discussion would not be complete unless we heard from Mr. Walker. [Applause.]

MR. WALKER. When gentlemen speak about another committee, I want them to understand that your present Committee has done the very best it could. I don't think anybody could possibly have done more than Mr. Crandall has done, and I am sorry he had to do so much and that I could n't have done more, but I am an old man, and I did n't want to get into this any more than I could help. Now, I don't ever want to be put on another committee with these insurance fellows, for if there is anything in the world they can do it is to make long statements. Why, they can typewrite the whole Bible [laughter], and they will want you to read it; but they don't say anything about who shall pay for the supply which goes into one of their mills. [Laughter.] They leave that out entirely. They say they don't want to pay for it, and they make great objections to meters. I put in a meter one day and I thought I had it fixed all right, and then they came along and said the gate must be opened and the meter taken out, and finally I had to fix it so the mill man could get his insurance, and in the meantime the fire pipe was tapped; but I don't suppose the insurance people cared much about that.

I don't see that there is anything unfair about this proposition that Mr. Crandall, Mr. Hammond, and myself have made, that the manufacturers should pay for the privilege of having the water furnished to their buildings, because we have to keep the reservoirs in repair, and we have to keep the pumps in repair, and we have to do everything in order that they may have their pipes supplied with water. We certainly ought to have some compensation for it. I don't say it should be very much, but there ought to be some. You can tell a man he will have to pay $40 or $50 or $100, whatever you think he ought to pay. I should say he ought to pay more for a 6-inch pipe than he would for a 4-inch; and I am satisfied that a 2-inch pipe in most cases will do. If you have 80 pounds pressure and a 2-inch pipe through the mill, it will wet down considerably; I know it would in my house anyway. They refuse to pay one single cent, but I think

*Superintendent of Water Works, Manchester, N. H.

it is no more than fair that they or the insurance folks or somebody should pay for it. Mr. Cook used to be a water-works man, and in those days he stuck to the ship. [Laughter.] Now he has become an insurance man, and I don't take any stock in what he says. [Laughter.] He can get up and address this meeting a good deal better than I can, but I don't take any stock in him now, because he is an insurance man. He gets more pay, — all these insurance folks get more pay than we water-works men, — and so I don't blame Cook. [Laughter.] All I have to say is that I think it is fair that we should have some compensation for the water we furnish to the mills.

THE PRESIDENT. Notwithstanding what Mr. Walker has said with regard to insurance men, I am very sure we shall all be glad to hear from Mr. Cook.

MR. BYRON I. COOK.* Mr. President, I am very sorry that I have lost the support of so able a man as my friend from Manchester, for I hoped he would still stand by me as he has many times in the past. But I think the olive branch of peace has been brought up from the South, and Mr. Kimball's idea is a good one. It seems to me that we are really very near together. What is wanted is a device of some sort to be placed on the fire supply that will be accepted by both parties. There is no doubt that some such thing is needed.

Now, so far as the matter of charging for fire protection is concerned, it seems to me that every city and town has a duty to protect its manufacturing industries. The factories in a town are what support the town and give it its income, and when competition is as brisk as it is to-day no town can afford to lose its factories by fire and run the risk of their rebuilding elsewhere. I think the suggestion that a committee be appointed from this Association to confer with committees from the National Board of Underwriters and from the American Water Works Association, with a view to devising some plan by which the water interests and the insurance interests can be protected, is a good one.

MR. R. C. P. COGGESHALL.† There is one thing I have noticed about these fire supplies. Even assuming that the fire service uses no water, yet if a superintendent will take the trouble to put a meter on the by-pass around the main gate in one of these large factories,

* Inspector Associated Factory Mutual Insurance Co.'s, Boston, Mass.
† Superintendent of Water Works, New Bedford, Mass.

when they are not drawing a drop of water, he will be surprised to see how much water is going away in leakage underground in almost every case. I venture to say he will find from six gallons a minute upwards going, and it is almost impossible to trace it because it is going in such minute quantities. Now, should n't there be something paid for that amount of water, which is going all the time?

THE PRESIDENT. We should be glad to hear from Mr. Fiske, who is a member of this Committee.

MR. HENRY A. FISKE.* Mr. President, I do not feel like saying very much on this question. I was the last member appointed on the Committee, one of the younger men, and I simply tried to do my part in the committee work. Perhaps I have spoken a little freely in the Committee, but if I have it was because I felt strongly.

The one thing I am most sorry for is that the Committee could not have brought in some sort of a unanimous report, not so much on account of the good that that report might have done, but because it might have avoided giving the impression to some people that there is any antagonism between the water-works interests and the insurance interests. As matter of fact there is none and should be none. There is no reason for any antagonism, not the slightest; and the only reason that there was any difference of opinion in the Committee was because the members took different views as to the equity of the case on just one point. On the main features of the case under consideration, and those which I think will be by far the most important in the future, we were entirely agreed. One great feature, it seems to me, of the work — and when I took it up I, perhaps wrongly, imagined that that was about the only feature this Committee was to take up — was that relating to properly guarding against the misuse of water. I knew that Mr. French had worked on the subject of the by-pass and other devices, our National Fire Protection Association had discussed similar devices, having had this thing up for a good many years, as to what to do to make sure that water was used for fire protection purposes only. The insurance people are with the water-works people heart and soul on that. There is no difference of opinion about it. We do not want the water used for anything but fire purposes. We believe it is an absolute detriment to the service to use the water for anything except the extinguishment of fire, and we impress that upon the assured: and if we find the assured using the water for any other

*Secretary, Underwriters Bureau, Boston.

purposes, we use our best endeavors to get him to stop doing it, and generally give him a positive command that it must not be done. And I know that it is a fact that the insurance interests throughout the country are working along in that same direction.

So, when you come right down to it, really the one subject which it seems to me this Committee had before it, or which any similar committee will have, is the question of devices for determining whether water is used for other than fire purposes. That is a very important question and one which will, I think, demand a great deal of work; and I am sure that the insurance people are ready to put their time and energies into this, in connection with the water-works people, in order to come to some conclusion which will be of advantage to all concerned.

Mr. French. Mr. President, if I may be allowed one word, I would like to heartily endorse all that Mr. Fiske has said. In business we are competitors, but when it comes to the matter of fire protection our interests are identical, because protection is something which is equally desirable irrespective of where the insurance is, whether the property is a "stock" risk or a "mutual" risk. One or two points have occurred to me as possibly helpful to this discussion, and I will try to state them briefly.

First, once for all, let me explain where we differ in *principle*. Mr. Crandall's position is that protected mills get considerable advantage in insurance rates, — and they certainly do, — and that they ought to pay something to the public for this advantage. But our feeling is this: A man pays taxes; you all pay taxes. Now, if your house takes fire the public department comes and uses the public water freely, without any charge to you, and puts the fire out if it can. You have that service because you pay taxes. The proprietor of a large dry goods store down town, whose store has no private protection whatever, is entitled to the same service, and it is not an uncommon occurrence for the public fire department to pour water on such a store all night, perhaps until there is nothing but the cellar left, and no one questions the owner's right to this service. Now, we have felt that a mill owner has a right to say to himself: "If I put in automatic sprinklers, the chance of a fire getting under way is much lessened, and consequently the chance of my plant being destroyed is greatly reduced. I am entitled to fire protection because I pay taxes, and all I ask is that I be allowed to have that protection through the sprinklers which I will buy with my own money." These

sprinklers are better tools for using the public water than the public can furnish to the community at large. The only way to get these better tools is for the individual to purchase them; and the owner of the protected risk merely asks that the water that is standing in the mains in the street, ready to be played on to his property if it takes fire, be allowed to stand on his sprinklers, because he believes that the water will do more good, it will be more effective on his sprinklers. Really, it seems to us that the man is helping the community to bear the general responsibility of extinguishing fires and lessening the chance of a great fire. Now, because we felt that having paid taxes he had paid for that protection once, we thought it was not fair to make him pay for it again; and although what Mr. Crandall wants to charge is possibly no more than the man will have to pay to reimburse the water department for reading the detecting device, when we finally have a perfect one, nevertheless we felt that there was a fundamental principle, a question of right, which ought not to be covered up by a compromise, and that is why we took the position which we did.

I want very much to emphasize what Mr. Fiske says, that there should not be any antagonism between the insurance interests and the water-works interests, and we want to work harmoniously and strive for the same end. We are absolutely opposed to the stealing of water, and it ought to be stopped in every place where it is discovered. We feel that perhaps, after we have settled the principle of the thing in our minds, the chief work for us will be to find some sort of a detective meter, to devise some arrangement which cannot be objectionable to anybody, something that will not in any way decrease the efficiency of fire protection, and something that will give absolute security against all improper uses of water through the fire service. We have put a good deal of time into the consideration of that matter and made a good many experiments, and we think that something will eventually be developed.

Now, one other point is this: Mr. Walker has raised the question of the amount of water needed, and I just want to say that all our experience goes to show that now and then there comes a fire which will open fifty or one hundred automatic sprinklers. That happens sometimes owing to the fact that the fire burns in a place which the water cannot reach. For instance, in the mule room of a cotton mill it is not uncommon to have a fire in the mule-carriage. We had one the other day which opened two hundred sprinklers; if the water

supply had been better it would not have done it. But the fire sometimes burns in such concealed places, necessarily concealed in this case, because you cannot put sprinklers in a moving carriage; and the heat spreads through the room until the number of sprinklers which open is sufficient to pour out water fast enough to cool that heat as fast as it is made, and then no more sprinklers open. Now, if you limit your water supply to a very small pipe, the heat may go the whole length of the room and open every sprinkler, and when the large pipe is turned on, as Mr. Walker suggests, there will be a very heavy water damage; while if you have ample water to supply all the sprinklers which open at the very start, that water will catch the fire in its infancy and hold it, and you can perhaps shut the water off in a few minutes with a comparatively small loss. You take away from the great good of your sprinkler equipment the instant you throttle your water supply, for often you don't want many gallons in the total, but you may want a good many gallons in the first five minutes. That is a very important feature in fire protection.

Just one word more. As to this arrangement of Mr. Alexander's, I am afraid it would not be wholly safe in its present shape, because our experience with automatic dry pipe valves and various other automatic devices is that they are very likely sometimes to fail; and further with automatic sprinklers, if you had to wait until somebody pressed the button and opened the hydraulic valve, you would probably hamper your sprinklers at the start, when they need water the most. But somewhere among these various devices there will be something found which will give us a chance to stop all the improper use of water, which is very rightly named stealing, and when we get to that point I think that this question will very largely disappear, and that all water departments will be very glad to do all they can towards putting out fires, providing they can be sure that their fire services will not be abused.

THE PRESIDENT. I will ask Mr. Chase if he desires to say anything upon the report which he has made.

MR. CHASE. Well, Mr. President, practically everything which has been said to-day has been a rehash of what we have heard at previous meetings, comparatively few new ideas having been advanced; and while I might assume that there is justice in my cause, yet I believe justice should be tempered with mercy, especially about dinner time, and as it is now half-past twelve, I do not think I will inflict any remarks upon you.

On motion of Mr. R. J. Thomas, the convention adjourned to 2 P.M.

Upon reassembling, Mr. Fred Brooks moved that the three reports presented by members of the Committee on Apportionment of Charges for Private Fire Protection and the Means of Controlling the Supply Thereto be received and printed. The motion was adopted.

MR. CRANDALL. I was not here when the convention was called to order this afternoon, and I do not know what action was taken in regard to the reports of the Committee on Private Fire Protection. I would like to know what action, if any, was taken on that matter.

THE PRESIDENT. The reports of the Committee were received and ordered to be printed. That was the motion which was made and passed by the Association.

MR. CRANDALL. If there has been no motion made to carry out the suggestion in regard to appointing a committee to confer with committees from other associations who may be sufficiently interested in the matter to appoint such committees to consider the question of the control of such private fire services — I understand there has been no such motion made?

THE PRESIDENT. No such motion has yet been made.

MR. CRANDALL. Then I would move that the Chair appoint a committee of three water-works men, members of the New England Water Works Association, residing within fifty miles of each other and within one hundred miles of Boston, to take up this matter with committees which may be appointed with other associations.

Adopted.

Mr. CRANDALL. Has there been no expression of opinion by the Association with regard to the different reports which were presented? There was a motion made this morning in regard to the adoption of one of the reports; was that acted upon?

THE PRESIDENT. All the business which was done, Mr. Crandall, was the passage of the motion to receive and print the report.

MR. CRANDALL. As a member of the Committee, I do not feel like making any motion in that regard, but it seems to me that an expression from the Association at this time would be very opportune.

MR. PAULISON. I move that Mr. Crandall's report be accepted and adopted.

A MEMBER. It seems to me that as we are about to appoint a

committee to confer with committees from other associations with regard to this matter, it might be somewhat premature for us at present to endorse any one of these reports. Perhaps it would be better to let the matter lie, to give the members an opportunity to think the matter over when they can have the reports in print, and at some future meeting they can endorse whichever report they choose.

MR. KIMBALL. While personally I am wholly in accord with the report presented by Mr. Crandall and his associates, I think myself that the better way to handle this matter now is to accept and print all of the reports, — there are some good things in all of them, there is no question about that, — and then give this new committee all the papers in the case, and let them, after consultation with committees of the American Water Works Association, of the Underwriters and other associations, if it is deemed best, bring in a report of what they think is advisable in the case.

I am sorry that Mr. Crandall in making his motion limited the choice of the President to certain districts, because that cuts out, perhaps, some members of former committees who have discussed this matter pretty thoroughly and are perhaps as competent as any one. If it is in order, I would move to amend the motion so that all limitations may be taken off the appointment of the committee, except, I believe, it should be composed of representative water-works men, and men, if you please, who represent both municipally and privately owned plants, as the underwriters, the insurance men, would naturally appoint a committee of their own to confer with our committee. If it is in order, or if it can be got at in any way, I think the limitation as to the location of the members of this committee should be removed. Will Mr. Crandall accept that as an amendment, if it is not too late?

MR. CRANDALL. I am willing to accept the amendment, providing you leave out the present superintendent of the water-works at Burlington, Vt. But the point I wish to get the sentiment of the Association on, and that I thought it would be advisable to have an expression of the Association upon, is that with regard to which the American Association has expressed its opinion, that is, as to whether this Association believes in free water for private fire purposes, or whether they believe that private fire services are assessable; and, also, on the other point as to whether there should be a limit placed upon the size of the services attached to the public

mains, — not necessarily a limit to the size of private fire pipes, but a limit to the size of any kind of services through which water may be drawn from the supply suddenly. The new committee appointed will be as much at sea with regard to what the opinion of the Association is on these two matters as we were. There is no question what the opinion of the insurance men will be, or of a man who is in charge of a large manufacturing plant, and if there is any considerable sentiment among water-works men in the same line as that which exists with the insurance men and the owners of the protected risks, I think it would save the committee a good deal of work to know it beforehand.

Mr. C. W. Sherman. I do not pretend to be very much of an expert in parliamentary law, but it seems to me that the original motion having been adopted by vote of the Association, the only way to make the change suggested by Mr. Kimball will be by a reconsideration of the vote and taking the matter up entirely anew.

Mr. Crandall. I am willing there should be a reconsideration on the terms I have mentioned.

Mr. George F. Chace. This present assembly is a very small part of the New England Water Works Association, and it does not appear to me that we can vote very intelligently upon matters about which we have never heard and know nothing. For my own part I do not know what the details of these reports are, and I should be glad to see the reports printed. It seems to me we could express ourselves a great deal more intelligently if we knew the details and had time to adjust them. I move that the whole matter be laid upon the table.

Mr. Paulison. I think if Mr. Crandall's report were adopted it would be a great help to the future committee to know the wishes of the Association.

Mr. M. N. Baker. I would like to make this statement: It seems to me that, inasmuch as the attendance now is so very much smaller than it was this morning during the discussion, or in the early part of the afternoon when the other motion was put and adopted, and inasmuch as some of the members who are interested in the discussion have, I believe, left the city with the understanding that final action had been taken, there might be an element of unfairness in re-opening the subject until notice has been given that it is to be taken up again. I say this without any regard to the manner in which my sympathies run on this general subject.

MR. CRANDALL. Mr. President, I appreciate the fairness of what Mr. Baker has said, but I would still like to know what the sentiment of the people here present is, not as a statement of the opinion of this Association, but simply for the information of the Committee as to what the opinion of the people now present is on the subject.

MR. CHACE. Does n't the motion to lay on the table take precedence?

THE PRESIDENT. I believe it does.

MR. FRED BROOKS. It seems to me if the motion to lay on the table prevailed it would still be open to the gentlemen present, if they chose, to make some informal expression, which would not go on record at all, as to how many favor and how many do not, the point suggested.

The motion to lay on the table is carried.

MR. KIMBALL. Now, with Mr. Crandall's permission, so that we can strike out the limitation, I move to reconsider the vote adopting his motion, with a view to offering it in another form covering practically the same matter.

Adopted.

MR. KIMBALL. Now, I would move that a committee of three be appointed by the President, whose duty it shall be to ask for the appointment of and to confer with similar committees from the American Water Works and other kindred associations, and also with the various underwriters' associations, to agree, if possible, upon some adequate means of controlling private fire supplies acceptable to all parties concerned, including therein all questions relating to charges therefor and similar matters.

MR. HAMMOND. I understand the question of payment is eliminated now, that it is simply to devise some means of detecting the use of water and has nothing to do with the pay; am I right?

MR. KIMBALL. I think the question of control includes payment as well as other questions connected with it. The question of payment is one form of controlling in all these things.

MR. JOHN O. HALL. I was not present this morning at the discussion of this subject, but I trust that the committee will have ample authority to cover the whole ground, because I believe it is a vitally essential point in the matter of water-works operation and control. A remark was made yesterday in reference to a just return to the water department for all demands made upon it, and it seems to me

that here is a question that the communities are vitally interested in. The community should not be taxed, the individual taxpayers should not be compelled to bear any burden which by any interpretation can pass into an individual benefit to somebody else; and this whole matter, it seems to me, should be very carefully considered, and the committee appointed should have ample power to cover the whole ground and take in the whole bearing. This is an element of vital importance to water-works departments, which are servants of the communities, and they should be very careful to protect the communities which they serve.

MR. SHERMAN. I rise to a point of order, Mr. President. If I understand parliamentary law correctly, the motion to reconsider the vote on Mr. Crandall's motion having been carried, the question now comes on Mr. Crandall's original motion.

THE PRESIDENT. Do I understand that Mr. Crandall accepts the motion of Mr. Kimball as a substitute for the original motion?

MR. CRANDALL. Yes; with the understanding that the President in his appointment will except the superintendent of the Burlington works.

Mr. Kimball's motion was adopted unanimously, and the President announced that he would appoint the committee later.*

MR. R. J. THOMAS. Inasmuch as the committee's report is not adopted, would n't it be well to discharge the committee now that you are to appoint another one?

MR. HAMMOND. I think the committee should be discharged, and thoroughly discharged.

MR. THOMAS. I move that the committee be honorably discharged.

MR. KIMBALL. With the thanks of the Association for the work which they have unquestionably put into this matter.

MR. THOMAS. I do not accept the amendment, for I do not believe in thanking committees. I move that they be honorably discharged.

Adopted.

*Subsequently the President appointed Messrs. F. H. Crandall, R. J. Thomas, and Elbert Wheeler as members of this committee.

APPENDIX A.

Statement of Conditions and Conclusions submitted by Messrs. Crandall, Walker, and Hammond, to the Fire Pipe Committee.

Investigations and experiments made for our Committee develop the following conditions: —

Water-works systems, both public and private, as we have them, are generally constructed with at least a double purpose in view, — the furnishing of fire protection and of water supply, both of which, under some circumstances, may be regarded as public necessities. In most cases it is not until a combined necessity becomes apparent that water works are built. Whether the necessity rests principally on account of the fire protection or the water supply afforded by the works, it matters not, as the need of either is sufficient to warrant the claim.

It is often forcibly impressed upon those in immediate charge of a system that much necessary work might more easily be accomplished and large expenditures frequently avoided were it not for the temporary impairment of some one's fire protection.

In case of public ownership of the water plant, the practice of making, in one way or another, a contribution toward the expenses of the water department in recognition of public fire protection afforded, and that of furnishing private fire protection and permitting fire services to be used for other than fire purposes without the knowledge or permission of the department, and without remuneration, is quite common.

Public sentiment, or the sentiment of the law-making representatives of the people, is found frequently averse to the strict enforcement of ordinances generally enacted for the prevention of the misappropriation of water.

Under public ownership, private fire protection has been frequently furnished without charge, the understanding being that such services should not be used for other than fire purposes, that the cost to the water department would be inconsiderable, and that the value of the protection afforded was not so great as by its free concession to constitute an injustice to other taxpayers.

Furnishing fire protection in accordance with present ideas necessitates larger mains than formerly, and much larger mains than, but for rendering private fire systems efficient, would prove amply sufficient. In recent years a large part of the annual expenditure of many works has been solely on account of fire protection. Pipes are everywhere being replaced with larger sizes for no other reason than to maintain the efficiency of plants for private fire protection.

Wherever pipes supposed to be used for fire purposes only are in use, water in considerable quantity is taken from them occasionally, if not habitually, for other uses.

The general public have had no opportunity to become aware of the extent to which the confidence reposed in the users of private fire services has been misplaced, nor have they had occasion to become possessed of correct information as to the value of the service rendered in permitting the connection of private fire protective plants with the public mains.

Every year's additional experience is making more apparent the shortcomings of the schedule rate and the so-called free systems, both in that

they offer no incentive to individual economy and thrift, and in that they indirectly encourage wastefulness and a disregard of the rights of others.

With the increasing popularity of the meter system, and its accompanying idea that one should pay for water in proportion to its use, the idea that the expense of fire protection should also be borne by those benefited in proportion to benefit received has gained in popularity.

With the increase in the number of small takers, ordinarily paying the minimum meter rate, and occasionally paying a larger bill on account of waste, a strong sentiment in favor of requiring every taker to assume the responsibility of meeting the expense of his own waste is developing.

The inadequacy of any means, short of placing the cost of waste upon the parties permitting it, to prevent the useless and unnecessary waste of water, has been repeatedly demonstrated.

It has developed that, under either the schedule rate or the so-called free system, no reasonably adequate supply can long prove sufficient.

The amount of water legitimately used or wasted by private fire pipe systems is not inconsiderable. The cost to the water department of maintaining the efficiency of private fire systems is not a small item. The pecuniary benefit accruing to the possessors of such systems in saving of insurance premiums is real, tangible, and considerable.

There is no question as to the value of and benefit to be derived from properly installed systems for private fire protection; nor is there any question as to who is the directly benefited party. The general public, like the beggar at the rich man's table, gets some crumbs of benefit from private fire protection, but there the parallel ends. The public is asked to foot the entire bill. Though the town derives benefit from the presence and from the sprinkling of its manufacturing industries, they are neither built nor rebuilt nor sprinkled for the benefit of the town.

Reasonably trustworthy evidence in regard to the method of use of private fire pipes is to be had at small expense.

The matter of expense necessary to be incurred in securing reasonably trustworthy evidence in regard to the method of use of private fire pipes is of no consequence whatever, as, be the expense what it may, it will, in a very short time, be returned manyfold in the prevention of waste, if in no other way.

Losses of ten pounds or more in pressure are not infrequently traced to leaks from private fire services, which have, perhaps, been running for months, but which, inasmuch as they did not cost the mill people anything, they did not feel were of sufficient consequence to merit attention.

In furnishing fire protection in the manner which has become quite generally the custom, even with the utmost care and the best installation, a risk, not only of absorption to no purpose of pressure, perhaps sorely needed on the premises or elsewhere, but also risk of unremunerative use and waste is assumed. The risk of loss of pressure here referred to is that of the entire absorption to no purpose of the fire protective efficiency of a plant, as by the discharge from a line broken by falling walls or from sprinkler heads in an already doomed building or in a building where the fire has been extinguished.

Such utter destruction of the fire protective efficiency of the water plant was experienced at Manchester, N. H.; Jacksonville, Fla.; Columbus, Ind., and other places, on account of the presence of unreasonably large services.

Very few of our systems can suffer the breaking of a 6-inch service and yet furnish fire protection to the neighborhood, hence the unwisdom, if services of that size are to be permitted at all, of permitting them to be so located as by any possibility to become broken.

The gate, supposed to be so located as to be accessible under any probable combination of circumstances, is about as apt to get shut when it should be shut as the gate on a by-pass around a meter is to get opened when it should be opened.

An investment in private fire protective appliances, supplemented by many times the amount invested in a water-works system, secures a saving in insurance premiums due to the entire amount contributing to the protection of the plant, and ordinarily affords the owner a large return on the comparatively small amount invested in private appliances.

The owners of private fire protected plants would have it understood that a water company or department is not entitled to remuneration for private fire protection, but only for the cost of connecting to such fire protective systems and the cost of reasonable supervision of the use of water from them.

Complex systems of cast- and wrought-iron pipe under from forty to one hundred and twenty pounds pressure can be maintained with scarcely any leakage. Such services are, nevertheless, where the conditions are such that waste costs the taker nothing and repairs are expensive, frequently found wasting considerable quantities of water.

These conditions have been demonstrated with particular clearness and force where the use of water for some time, without the knowledge of the user, measured, has been transferred from the schedule or so-called free list to the metered class. Premises where the users of water pay for use and waste at meter rates in proportion to the amount supplied are being satisfactorily served with one fourth the amount which was consumed when the water department, and not the careless and extravagant consumers, suffered the loss incident to waste.

Nowhere have these conditions been more conspicuously demonstated than in instances of public use. The caretakers of public premises where constant leakage from closets and other fixtures, and from fountains during the night time and during rain storms, has been the custom, have, when the loss incident to permitting such conditions was placed upon them, found that just as satisfactory results could be achieved with from one fourth to one third the amount of water used under the plan in vogue when the loss due to waste did not come out of their appropriation, and the benefit resulting from the better example has been worth more than the saving in water.

Statistics of like and even more advantageous results, achieved by causing the waste from private fire pipes to fall upon those permitting it, are not wanting.

The mill mechanic is not, and is not generally considered, the responsible cause of certain peculiar practices in regard to the use of private fire pipes, which have in numerous places come to light.

The agent, owner, or managing stockholder, who smiles when his engineer explains to him the ease with which the fire service may be tapped, and the party who, under the mistaken impression that he thereby furthers his own pecuniary interest, fosters the impression that a charge for private fire protection is unjust, and suggests means for "getting even" with the water company, are, beside public opinion, the forces to be reckoned with in an attempt to improve present conditions.

We find no means of securing reasonably trustworthy information in regard to the use of services used for both fire and other purposes. In regard to the use of such services, it appears that the manufacturer who told one of your Committee that, in spite of the best efforts of the water department, he could obtain, without their knowledge, all the water he wished from his fire service, was possessed of information on the subject no less accurate than that born of experience.

It is not on account of the illegitimate use which is likely, sooner or later, to be made of private fire pipes that meters are used, and a charge is, in many places, made for private fire protection, but for the prevention of waste, and because the protection thus afforded is of value and not reasonably to be granted for nothing.

The city of Burlington, Vt., has for years been dependent for fire protection upon the automatic opening of a by-pass around the motor used to

supply the high service, and has yet to experience any difficulty on that account.

Metered by-passes around weighted check valves are, in different places, affording means of securing, at small expense, reasonably accurate information as to the amount of water used through certain classes of services.

Metered by-passes of a much smaller size than the fire services, around gates in which they are placed, are, in some places, systematically used to determine the amount of leakage from services so equipped. Either the proportional device upon which the Factory Mutual people are at work, or a device such as is in use at Wilkinsburg, Pa., will furnish accurate information as to whether a service is used or not. As to the amount of water taken from a service, neither is constructed to furnish accurate information. For use on street sprinkling standpipes, or elsewhere, where the stream drawn is always the full capacity, either device affords reasonably accurate information as to the amount of water passing through it.

So far as we are able to learn, the device in use in Wilkinsburg, Pa., and some other places, for securing information in regard to the use of private fire pipes, is efficient, and not liable to get out of order. It consists of a hydraulic valve, with a small drip opening the instant the valve leaves its seat. By means of a meter on a waste pipe from the drip, the length of time which the valve remains off its seat is ascertained. The valve may be opened by means of stops on small pipe lines conveying hydraulic pressure to its operating chamber, from as many points as may be desired.

Superintendent W. S. Hamilton, of Youngstown, Ohio, has applied for a patent on a device consisting of a small metered by-pass around a large meter and check valve, which, it is stated, will be accepted by fire insurance companies.

We have been able to agree with the members of our Committee representing the owners of private fire protected plants and the insurance people on the following propositions: —

First. That the owners of private fire protected plants would have it understood, as was formerly quite generally the case, that by means of their private fire protective appliances, put in at great expense to them, they merely utilize to greater advantage protection to which they are legally entitled, and are not the recipients of any special service or protection.

Second. That stealing water from fire services is not right, and should be stopped.

Third. That the obtaining of trustworthy evidence in regard to the use of private fire protective systems is a growing tendency, and is entirely reasonable.

Fourth. That under schedule rate, or so-called free service, the appeal to the pocketbook is in favor of increased waste rather than economy, repairs being expensive, and a continuance of waste costing the taker nothing.

Fifth. That the work of this Committee will be of more value if mainly directed to securing a remedy for the misuse of private fire connections, rather than to the preparation of elaborate records of past abuses.

Sixth. That on every fire service running into a building there should be a main gate, so located as to be accessible under any probable combination of circumstances.

Seventh. That a charge for a permit to connect, equal to the cost to the public or to the water company, as the case may be, of the connection, would be reasonable and proper.

Eighth. That an additional charge for each additional hundred feet of water used in excess of the amount allowed for the minimum rate would be fair and reasonable.

Ninth. That in a constantly increasing number of cases, where to secure fire protection and water supply for a reasonable sum it has become necessary to limit the consumption to legitimate uses only, no so-called free use

and no waste being permitted, metering of private fire services is certainly a growing tendency. We, however, do not expect the custom to become universal for many years, if ever, and we think that probably, in a number of cases, metering will not be necessary, such methods as are employed in New Bedford and Providence perhaps, under some circumstances, sufficiently safeguarding the interests of the public.

Tenth. That existing conditions undoubtedly create a tendency to use meters of the ordinary commercial types for fire services. Our feeling is, that though present types of meters are not entirely satisfactory for the work, on the one hand through their inability to measure small flows, and on the other because of their possible excessive obstruction in case of large demands, they will, unless something more satisfactory is devised, probably be placed on private fire services.

Eleventh. That as a general proposition, taxpayers, required to pay for all they use and waste, may reasonably demand that others do the same and that trustworthy evidence, such as an automatic machine only can furnish, in regard to the use of a service, be secured in regard to the use of every service attached to the public mains. We, at the same time, appreciate that probably, in many cases, the interests of the public may by other means be duly safeguarded.

Existing conditions are, we find, in various ways demonstrating the impropriety of furnishing private fire protection for nothing. From the conditions as we find them, we would draw the following conclusions: —

The conditions encountered in different places are so different as to render impossible any conclusions of general applicability in regard to the amount or method of making a fair and equitable assessment for private fire protection.

The understanding that a service, supposed to be used for fire purposes only, furnished as has been the custom, will be used for no other purpose; that the cost of maintenance of such services for such purposes only is insignificant, and that the value of the protection afforded is not so great as by its free concession to constitute an injustice to others, is, in every particular, a misunderstanding.

The improper use of services, relative to the use of which no means of securing reliable information is furnished, is a natural consequence of their existence, to which the small value frequently placed upon private fire protection largely contributes.

It is not unnatural that the appropriation of a commodity esteemed to be nearly, if not quite, valueless, should be regarded as a trivial matter. Wherever the misapprehension, quite common at present, as to the value and cost of fire protection is coupled with an apparent willingness of water rate payers to bear the burdens of others, the present rates or lack of rates for private fire protection and the present method of use of such services may reasonably be expected to continue.

It is not wholly the well-known tendency to generosity with other people's money, but largely a lack of correct information as to the value of the service rendered, which is responsible for the discrimination frequently existing in favor of the ownership of private fire protected plants.

The granting for nothing of so valuable a service to parties abundantly able to pay a reasonable price for it is not charity, and amounts to more than ordinary generosity. It amounts to an injustice to other rate payers, which, in view of the fact that in the establishment of rates for the service of a public monopoly, neither charity nor generosity but justice only ought of right to figure, is conspicuously ill met.

Where the furnishing of private fire protection results in either expense to the furnisher or in benefit to the recipients of the protection, there should, in justice to all concerned, be a proportionate assessment.

With an increase in either the value to the applicant of the protection afforded, the cost to the water department of affording the protection, or

the risk to other interests entailed by the attachment desired, the rate for private fire protection should increase.

All known safeguards having been provided to lessen the risk to other interests, incident to the attachment of a large service to the system, the only way of meeting the unavoidably remaining risk is by its assumption by some one.

Though there are occasional instances of the assumption of a risk by one party for another without remuneration, the practice is not general, and we see no reason for its adoption by water departments.

By causing the rate charged for private fire protection to increase as the risk to other interests entailed by the service is increased, the creation of needless hazard incident to unnecessarily large services will be discouraged.

Large services, for whatever purpose, carry with them an element of danger to the neighborhood, and care should be taken not that fire pressure may not be accidentally destroyed, but that it must not be accidentally destroyed.

The misapprehension, which has become quite common in regard to the value of fire protection, results, it seems to us, largely from the practice of thinking and speaking of furnishing water for fire protection, instead of speaking and thinking of furnishing fire protection.

The extra cost of furnishing facilities for securing water in volume sufficient for fire protective efficiency is not conspicuously apparent to those not versed in such matters. To such a bill "for water furnished for fire protection," particularly if no water or very little water has been so used, is a stumbling-block.

Inasmuch as at current prices the cost of furnishing the water used for fire purposes forms so small a portion of the cost to the water department of furnishing the protection, a bill for "fire protection afforded," the form of expression in use in many places, is technically more correct, and perhaps affords less opportunity for misunderstanding.

That there should be misapprehension in some quarters in regard to the value of fire protection is not particularly strange. The minimum meter rate has often, at first, by some been regarded as an injustice. With better information on the subject, the legality and propriety of such a charge has come to be generally recognized, and meters for small consumers, expecting to pay the minimum rate, are in demand. With the increase of correct information on the subject of fire protection, a reasonable charge for fire protection, both public and private, will also be not only appreciated but demanded.

While differences of conditions to be met with in different places seem to render conclusions in regard to the amount and method of assessment for fire protection which shall be generally satisfactory out of the question, the relative value of services of different sizes is, under the various conditions encountered, approximately the same, and the charge for a 6-inch service may reasonably be made not less than from four to six times that of a 2-inch service under like conditions.

The water company or department placing at the disposal of a patron a plant the fire protective efficiency of which he could not duplicate for a hundred thousand dollars or more, and which it has, perhaps, cost several hundred thousand dollars to develop, is entitled to reasonable compensation for benefit in the form of fire protection, as well as in the form of water supply derived from attachment to the plant.

There is no doubt that in the past water companies have quite generally derived an unreasonably large proportion of their revenue from those to whom they have furnished water, to the great pecuniary advantage of those to whom they have furnished fire protection.

All that can be said in favor of the meter system in preference to the schedule rate system applies with equal or greater force in favor of secur-

ing reasonably trustworthy evidence in regard to the use of private fire pipes, in preference to furnishing such service without control or remuneration.

No municipal or private corporation can afford to imperil its plant and put its property where it can be used without its knowledge or consent, trusting to the user to make proper compensation.

A plumber could not be legally or reasonably compelled to permit A, B, C, and others to help themselves to his wares, trusting to them to make him a proper return. This very unusual method of doing business is no more legal or reasonable when applied to a water company, either public or private.

To the rule that everything may be carried to an extreme, the size of an automatic sprinkler supply is no exception. In this case we feel that the extreme is quickly reached. An automatic sprinkler may, by being at the right place at the right time, prevent a conflagration. Ordinarily the fire which opens more automatic sprinkler heads than a 4-inch service will supply has passed beyond the automatic sprinkler class, and brains are required for the direction of the deluge necessary to arrest its course. In any case, such a service should not be permitted without facilities for the prevention of its becoming a damage instead of a blessing.

The interest and other expenses of maintenance, a proper sinking fund contribution included, together make up the cost of supplying water and fire protection. To meet this expense, each party deriving benefit in any form from the maintenance of the plant should be assessed in proportion to the benefit he receives and his ability to pay.

Reasonably reduced rates to wholesale consumers of water are, provided for like quantities of water the rate is always the same, legal, and in such case do not create a material, if any, departure from assessment in proportion to benefit.

The claim that any sharer in the advantage, of whatever nature, conferred by a public water works should be exempt from making a proportionate contribution towards the general maintenance of the plant, interest included, is not well founded.

Referring to the four definite questions submitted to us, we find, —

In regard to the first, as stated a year ago, the opportunities for taking water, without the knowledge of the water department, afforded by the presence of private fire pipes, are frequently taken advantage of.

In regard to the second, the benefit to the general public from the presence of private fire pipes is not sufficient to warrant the assumption by the general public of the expense incident to furnishing them with water.

In regard to the third, the service rendered in supplying water for fire purposes only for private fire pipes, merits compensation.

In regard to the fourth, securing assurance of the use of private fire pipes for such purposes only is a matter of small expense, and may reasonably be required.

The cost of private fire protection may reasonably be estimated at a certain proportion of the total cost of fire protection; which latter often falls between one third and one half the total maintenance account, interest included.

The value of the protection afforded is many times its cost, and should be assessed upon those directly benefited. A percentage of the insurance premiums paid will, in many cases, furnish a satisfactory method.

In some cases it may be well to recognize the different fire protective efficiency due to different pressures. It is, of course, desirable that a rate be in proportion to the value of the service rendered. In case, however, of private fire protection, a very close approximation to such a rate it is next to impossible to determine without the coöperation of parties too deeply interested to admit of fair and unbiased action on their part. In public works, too, the charges are, and we think are liable for some time

to remain, so small a proportion of the value of the service that extreme accuracy in the detail of minimum assessment is uncalled for.

A minimum rate based upon the size of the service, in so far as the size influences the value to the user, the cost of maintenance and supervision, and the risk entailed upon other interests, somewhat in the following proportion, would be reasonable.

Taking a 6-inch service, without other information in regard to its use or other means of control than the assurance of the owner that it is used for no other than fire purposes, as a standard for comparison, minimum prices for fire protection in the following proportion would not be unreasonable.

	Size not limited. No definite control.	*Size limited. No definite control.*	*Size not limited but controlled.*	*Size limited and controlled.*
6-inch,	100%	75%	60%	40%
4-inch,	50%	35%	30%	20%
3-inch,	25%	20%	15%	15%
2-inch or less,	20%	15%	10%	10%

Larger services, proportionately larger prices.

Each of the above percentages has reference to the price established under the particular prevailing conditions for a 6-inch service understood to be used for fire purposes only, with no other information in regard to, or means of control of, its use than the assurance of its owner that it is used for such purposes only.

While a generally applicable rate or method of assessment is not to be expected, for minimum rates prices for less than which services of the sizes and under the conditions named will not be furnished, in the above proportion will ordinarily be found reasonable.

For water actually used to put out a fire, no additional charge over and above the minimum charge for fire protection, is contemplated.

We would direct attention to the recommendations of the American Water Works Association in regard to this matter, promulgated at their recent meeting in Chicago.*

This report, Mr. J. M. Diven, secretary of the American Water Works Association, informs us, was unanimously adopted by that association.

We heartily commend the action taken by the American Association, but would amend the first, fourth, and seventh paragraphs to read as follows:

First. That all applications for attachments to street mains for private fire service be accompanied by a draft or plan of the proposed pipe system intended to be used upon the property to be protected, together with an agreement that the service applied for shall be used for no other than fire purposes.

Fourth. That the attempt to secure large services for fire or other purposes, without furnishing reasonably trustworthy evidence in regard to the method of their use, is unreasonable, and should not be permitted by the purveyors of water and fire protection, whether acting for public or private corporations.

Seventh. That to avoid the surreptitious use of water, services unprovided with suitable devices for determining with reasonable accuracy the method of their use be not permitted.

A metered by-pass around a butterfly valve, arranged to automatically open and become locked open on a drop of pressure on its outlet side, or a metered by-pass around a weighted swing check, opening toward the private system in such manner as to throw its weight and become locked open upon a drop in pressure on its outlet side, or such unautomatic device as is in use at Wilkinsburg, Pa., may, without at all impairing the fire protective

*See page 303.

efficiency of the service, if permitted, furnish reasonably trustworthy information in regard to the use of a service used for fire purposes only.

The espionage necessary to insure the use of private fire services for no other than fire purposes is irksome to both the inspector and the inspected, and its long continuance is impracticable.

There are fewer places now than formerly where a small favored class get their water for about one fifth of the rate charged the general public, and a much better fire protection for the same rate as that charged the general public.

Though there is no more justice in the very small taker getting his service at less than cost and at the expense of the larger takers than there is for the large takers getting their supply at less than cost and at the expense of the smaller takers, the fact that the latter has frequently in former years been the case, both as regards fire protection and water supply, affords the reason for the present reaction in the former direction.

Where a charge for private fire protection is made, it is ordinarily less than one tenth the value of the protection afforded. In our opinion those who oppose so reasonable a charge for private fire protection are standing in their own light, for with schedule rates free lists are becoming out of date, and if "you can't fool all of the people all of the time," a charge seems to us inevitable. It is to be hoped that a happy and equitable mean may be reached.

We would recommend that, provided trustworthy evidence in regard to the use of the service and reasonable remuneration for the protection afforded be furnished, such applications for private fire services as will not unwarrantably jeopardize other interests be granted.

APPENDIX B.

Statement of Conditions and Conclusions submitted by Messrs. French, Fiske, and Cook, to the Fire Pipe Committee, giving more fully the reasons for the Conclusions in the Report which they submitted to the Association, and also somewhat extending the Data as to Cost, Value, etc., of Private Fire Protection.

In this statement, the questions given were those originally submitted to the Committee, and have been taken up in this case as they furnished convenient subdivisions of the whole problem.

First. "Whether the opportunities for the taking of water without the knowledge of the water department afforded by the presence of private fire pipes are frequently taken advantage of or no":—

We have found that the manufacturing plants having private fire protection supplied with water from the public mains may be divided into three general classes: First, there are those with unscrupulous management who deliberately, even to the extent of making secret connections, take the public water in quantities as desired, with the avowed intention of getting something which they need for nothing. We think this class is not very large, but they furnish the more glaring examples of the abuse of fire systems, and they contribute largely to the suspicion with which the fire service is often looked upon by the water-works superintendent. Second, we have a class which, we believe, includes the greater part of all the cases where private fire supplies are improperly used, where there is no actual intention to defraud the public, but where, through thoughtlessness or from a lack of reasonable appreciation of the rights in the case, water is taken now and then from the fire system for any pressing need. In general, in such cases the chief motive is to quickly get a supply of water when an *extra* amount is needed, or when the ordinary supply, such as the mill pumps, happens to fail. Convenience, therefore, is the guiding feature, and where the propriety of such takings is considered at all, the action is justified by the feeling that the water is so very cheap that to take some now and then cannot be wrong when it is for an emergency. The third class comprises the risks which have very scrupulous management, or which, from training, have learned that such takings of water are very much objected to by the water department, and always, when discovered, bring an earnest protest, so that, from years of such schooling it is generally understood by every one on the premises that water must not be taken from the fire mains except for fire purposes.

The first class may take much or little, depending on their needs and their daring. The second usually have to draw the water from some special connection made for the purpose, as by attaching a hose line to a nearby hydrant or sprinkler drain valve, or in some other way, making the taking more or less of a temporary affair which, in most cases, would naturally be discontinued as soon as the unusual demand were over or the normal supply restored. Such takers may use considerable water in one emergency if their needs happen to be great, but probably such users of water would not in a year take a *total* number of gallons which would be more than a small percentage of the consumption of the community at large. In the case of the first or the second class of concerns there may be some waste of water from the fire system, due to leakage, which, where the management was either unscrupulous or lax, might be allowed to go on for a considerable time without remedy.

Deliberate stealing of water should be punished the same as any other

stealing whenever detected. The thoughtless taking of water should be stopped whenever found, and the offending concern made to pay a good price for whatever they may have used, the amount being estimated as closely as possible under the conditions. It should be very clearly pointed out to such managers that the taking of water in this way is absolutely wrong, and that the large mill has no more right to use the public water without paying for it than has the smallest householder.

Outside of the question of right and wrong, even if large total amounts of water are not taken, it does often happen that occasional draughts of this kind are at such a high rate of flow as to make undesirable disturbances in pressure in the system, which may be mistaken for breaks, thus giving the superintendent a good deal of trouble and anxiety. Further, they all add an element of uncertainty always annoying, and especially so in those cases where a superintendent is earnestly endeavoring to account for practically all of the water pumped.

Second. " Whether the benefit to the general public from the presence of private fire pipes is sufficient to warrant the assumption by the general public of the expense incident to furnishing them with water, or no ": —

We believe that private fire protection is in several ways a benefit to the general community. This being the case, we believe there is a sort of moral obligation, if not an actual legal one, to supply such systems from the public mains, and that, in most cases, it is the best of business policy on the part of the public to do this.

The expense to the general public would usually be nothing beyond the expense which would ordinarily be considered proper in providing water mains and hydrants in the streets surrounding the manufacturing property in question.

The above is based on the understanding that the cost of connecting the private system with the public mains will be borne by the protected plant; that some means entirely satisfactory to the water-works superintendent will be provided to insure that no water is used through the fire system for any purpose other than for fire, and that a yearly payment be made, sufficient to cover the cost to the water department of maintaining the necessary supervision. This supervision would probably come in some one of the ways to be suggested later, or in some better method which may eventually be developed.

Our reasons for believing that private fire systems are a benefit to the public are as follows: —

(*a*) A serious fire in a prosperous manufacturing concern is often a direct injury to a town or city, because such a fire, if only a partial destruction occurs, may throw a number of hands out of employment for several months, thus causing a direct loss to the community in wages earned. Again, if the fire is more serious and cripples the business entirely, the result may be, in these days of consolidation, the moving away of a valuable industry when a new plant is to be constructed somewhere. Further, a severe fire may easily spread and do damage to surrounding property.

(*b*) Good private protection, meaning complete sprinklers as well as pumps and yard hydrants, greatly reduces the chance of such a severe fire and renders the total destruction of the plant almost impossible.

This is because the sprinklers, covering every point, stand ready to put water on a fire night or day at the very instant that it starts. Further, conveniently located yard hydrants permit bringing powerful fire streams through short lines of hose quickly into use. The private system, therefore, uses the available water more surely and efficiently than is possible when depending upon street hydrants and a public department only, so that much less water is actually used than if there were no private system.

Therefore, we have considered that private protection is a benefit to the general public.

Our reasons for believing that there is a sort of moral obligation, and that it is good business policy to supply such private systems from the public mains, are as follows: —

(*a*) It has become the general custom for towns and cities to lay out their water systems with the idea of providing sufficient water for fighting fires, and then to provide public fire departments to use this water. The public, therefore, have, as it were, freely accepted the responsibility of extinguishing fires whenever they occur, using water and fire departments to their fullest extent for this purpose. It is also universally understood that any taxpayer is entitled to this protection.

(*b*) Private fire systems, as already fully explained, greatly reduce the chance of serious fires by providing extinguishing apparatus, which is even more efficient than that found in the best-equipped public fire departments.

(*c*) Such private protection costs from three to five per cent. of the destructible value of a manufacturing plant, and this expense is borne entirely by the owners of the protected property.

Therefore, owners of a manufacturing property who put in complete private protection are directly aiding the general public in meeting the common responsibility to guard against fire hazard. At their own expense they provide better tools for the public water to work with. For these reasons we have felt that it was good business policy to encourage owners to so protect their plants, and that it was only fair to permit the man who provides more efficient apparatus than that which the public can furnish to have ample water — always under proper regulations — to use through his apparatus when a fire comes.

Third. "Whether the service rendered in supplying water for fire purposes only to private fire pipes merits compensation or no": —

With all first cost of installation paid by the mill, and with a satisfactory guarantee in some way that water will be used through the fire service for fire purposes only, and with a well-laid-out system, having no greater chances for dangerous breaks than exist in any other part of the water-works system, and with a yearly payment proportioned to perfectly reimburse the public departments for reasonable supervision over the fire service, we believe that no further compensation is warranted. The reasons for this conclusion are fully given in answer to the second question.

Fourth. "Whether securing assurance of the use of private fire pipes for such purposes only is merely a matter of a few dollars, and may reasonably be required or no": —

We believe that assurance can be secured as to the use of water through private fire supplies at moderate expense, though no one thoroughly satisfactory method, applicable to all cases, is yet available. We have considered the following plans, one plan being the best for one place, another for another, and so on, letting the special conditions existing be the determining factor in each case: —

(*a*) *Simple Lay-out and Inspection.*

With small manufacturing plants, having a simple fire system entirely separate from pipes carrying water for manufacturing uses, and laid out in a direct and straightforward manner, so that the water-works inspector can quickly become entirely familiar with every part of it, and with mill yards so open that water could not be used to any extent without attracting attention, we are inclined to think that no further protection other than periodical inspections and a clear understanding with the mill management would in most cases be necessary. Simplicity is best where it is good enough, so that in such cases we would rather advise against additional apparatus.

(*b*) *Small Detector Meter in By-pass around Main Gate.*

In some cases a ⅝-inch by-pass has been piped around the main gate at

the entrance to the mill yard and provided with connections for quickly connecting in a ⅝-inch meter. The water-works superintendent, or one of his assistants, would then once in a while slip a meter into this connection and close the main gate without giving any previous notice to the mill people. If the small meter began to move, it was an indication that water was being used, and investigation followed, and the trouble was at once sought out. This plan requires a little time now and then, but gives a superintendent easy means of watching his fire supplies, and, after a few cases of violation, results in making the mill people much more careful. The water should, of course, be kept shut off for only a few minutes, and a man should remain at the gate ready to open it instantly if a fire should occur.

Coming now to the cases where the water-works superintendent feels that some permanent and positive device is necessary on the fire service, the following plans have been considered: —

(*c*) *Ordinary Meters.*

Some one of the regular commercial meters would naturally first be thought of in such a case, but, practically, none of the ordinary types are really satisfactory for this work. Piston or disk meters considerably obstruct the flow, and if their moving parts become blocked may almost entirely cut off the water. The current type of meter introduces less obstruction but is not satisfactory to many water-works superintendents from its inability to detect the smallest flows. Again, the fish traps used with most meters are very likely to become seriously clogged by leaves, pipe scales, etc., which are apt to be brought along by the scouring action of the very heavy draughts caused by fire duty.

(*d*) *Sealing Hydrants and Valves.*

This plan has been quite successfully carried out in New Bedford, Providence, and some other places, and provides for sealing all hydrants and sprinkler drain valves. The seals are put on by the water department, to be broken only in case of fire, a fine being imposed for breaks at other times which cannot be satisfactorily explained. With a well-arranged public water department, this system will generally work satisfactorily. It does not, of course, detect concealed taps made by unscrupulous persons, but does provide against all ordinary takings.

From the underwriters' standpoint such sealing is not wholly desirable, and its general introduction throughout all private systems would be looked upon as unfortunate. This is from the fact that sealing tends to take the responsibility for the fire apparatus away from the mill force and leads them to rely more and more on the public fire department. Experience has shown the underwriters that good mill fire brigades are desirable even where there is an efficient public fire department, as the mill brigade, knowing the ins and outs of the mill buildings better, can often extinguish small fires with less loss on account of this knowledge, and further, every once in a while they are found absolutely necessary to guard the mill property when public departments are using their entire force and energies on a severe fire outside of the mill yard. Anything, therefore, which takes incentive from the mill brigade is somewhat undesirable.

(*e*) *Proportional Meters.*

In this type of measuring device a small meter — one-, two-, or three-inch — is put in a by-pass around an ordinary check valve, the clapper of which is perhaps weighted. Such devices, we believe, have promising possibilities. We have considerable data at our disposal on tests of meters of this kind. We have not as yet had time to develop what we believe is the ideal arrangement, but, even with present data, a metering device can be laid out which will detect very small flows, and which will give a fairly good measure of the water which passes through it. After some additional investigation we think it altogether probable that we could make definite

suggestions and furnish sketches for such meters, under different conditions, which would produce devices that would be satisfactory to the waterworks superintendent and entirely unobjectionable to the insurance interests, and which would be serviceable in a great many cases where a permanent metering device or detecting device of some kind is desired.

There are several other devices of special design which have been suggested, but which as yet have not been fully investigated. It seems altogether probable that along some of these lines will be found a metering device which will be entirely satisfactory and in every way unobjectionable. Such a device would go a long way towards solving this problem, and it is earnestly hoped that further encouragement may be given to such investigation.

Fifth. "Any other facts in regard to private fire pipes, the manner of their use, the value and cost of the protection afforded, upon whom and how the cost of such protection should be assessed, etc., which the Committee may see fit to present": —

(*a*) *Manner of Use.*

All extensive private fire systems are laid out by the engineering departments of insurance associations in coöperation with the engineer of the mill. The underlying principle is to secure the simplest possible arrangement of the fire pipes. Outside gates with indicator posts are provided on all connections going outside of buildings. The aim is to locate these so that they will be surely accessible under any condition of fire, thus making it possible to cut off a broken connection and save the waste of water. The underwriters always require, where it is possible, the absolute separation of the pipes used for mill supply water from the fire systems. Protected mills are usually in a selected class and receive regular inspection, thus tending to keep the fire apparatus in reasonably good order. The underwriters always advise that the requirements of the public water departments be carefully ascertained and strictly lived up to, and that plans of the proposed private system be submitted to the water department whenever they desire them. In general the underwriters desire a yearly test of the yard system, putting on several lines of hose and running water for a few minutes, the idea being to represent actual fire conditions and ascertain that the whole system is in proper working order. This test often discloses partly closed gates, thus showing the value of periodic testing. The underwriters always advise making such tests strictly under whatever regulations may be made by the water department as to testing, and their inspectors are instructed to carefully follow all requirements thus laid down, giving notice to the water department in advance of testing wherever it is desired.

(*b*) *Cost of Protection.*

Modern protection means automatic sprinklers throughout practically all buildings, a good supply for these sprinklers from public mains or private elevated tanks of large size, and a secondary supply, generally from fire pumps. Pipes are then laid through the yards to supply the sprinkler connections and private hydrants. The cost of such equipment averages from three to five per cent. of the total value of the property which could be destroyed by fire. A modern manufacturing plant of moderate size is easily worth $300,000, so that the protection of such a property would ordinarily cost from $9,000 to $15,000. This cost is entirely borne by the owners of the manufacturing concern, and in addition to it there is, of course, a constant annual cost of moderate amount for keeping the system in first-class condition all the time.

(*c*) *The Value of Protection.*

The value of protection comes first from its efficiency in reducing the great annual fire waste of the country, and second from the freedom from

interruption of business which a bad fire always causes. The annual fire loss in the United States is from $100,000,000 to $200,000,000. This means so much actual value burned up, and this loss is paid for in the long run by the community at large. Each one of us contributes his small share. The insurance companies are the means by which this great loss is distributed over the whole community in a fairly uniform manner, so that no one of us feels his contribution very heavily, but we are none the less the losers and would be just this amount better off if the fire waste could be stopped.

The efficacy of protection in preventing these wastes is shown by the figures for the year 1900 for a group of protected risks. This group consisted of concerns manufacturing cotton and woolen goods, paper and general metal work, with an aggregate value of about $900,000,000. Four hundred and fifty fires were reported, with a total loss of only $550,000. Of the 450 fires, 379 occasioned the loss of less than $1,000 each; 59 less than $10,000 each, and only 12 caused a loss of over $10,000 each. In the case of the 12 fires where the loss was over $10,000, there was in every case some peculiar condition,—either deficiency in protection, or some accidental feature which allowed the fire to cause excessive damage.

When it is considered that many of these risks have inflammable stock like cotton, and that they all contain large amounts of fast-moving machinery, so that under ordinary conditions many fires and large losses would be expected, it is seen how very efficient good private protection can be, and how great its value is as a means of preventing our enormous annual fire wastes.

(*d*) *Upon Whom and How the Cost of Protection should be Assessed.*

We have already seen that the first cost of the private protected equipment is entirely borne by the owners of the protected plant, that the first cost and all cost of making connection to the public mains is borne by the owners of the protected plants, and that the owners should pay a yearly amount sufficient to completely reimburse the public water department for all reasonable cost in so supervising private fire service that they may ensure its use for fire fighting only. We believe that it is right and proper that all of these costs should be paid entirely by the private protected plant. This leaves no expense to the public department except the laying of water mains and the providing of hydrants in the streets around protected property, a work which they would ordinarily be expected to do entirely regardless of whether the manufacturing plant has private protection or not. Street mains sufficient for the reasonable protection of a property would ordinarily be sufficient to give ample supply to any private equipment, so that, in general, the private equipment makes no requirement on the public in addition to what the public would ordinarily be expected to do for any taxpaying property.

We believe the above covers all cases except the occasional one where a large manufacturing plant is located well beyond the limits of the public water supply, but still within the bounds of the town or city. In such cases we believe it reasonable, where conditions will allow, to extend the public water supply to the manufacturing plant, but to apply exactly the same rule as is applied to the extension of water mains into any district as yet thinly built up, namely, to assess a yearly charge on the manufacturing plant sufficient to pay a fair interest on the cost of the pipe extension, allowing this charge to be eventually eliminated if the natural building up in the vicinity brings an equivalent revenue from ordinary water takers. This is simply the application of an old-established rule, and we believe it is just as fair for the large manufacturing plant as it is for the one or two small householders who build beyond the limits of the water supply. Of course, if the manufacturing plant in question desired to use a considerable amount of public water at regular meter rates this, in itself, would often justify the extension outside of the fire protection question.

FINAL REPORT OF THE COMMITTEE ON STANDARD SPECIFICATIONS FOR CAST-IRON PIPE.*

FREEMAN C. COFFIN, DEXTER BRACKETT, F. F. FORBES, COMMITTEE.

[*Presented September 10, 1902.*]

BOSTON, September 1, 1902.

TO THE NEW ENGLAND WATER WORKS ASSOCIATION:

Gentlemen, — Nine months have passed since your Committee made its preliminary report and offered a draft of Standard Specifications for your consideration. The subject was discussed at two public meetings of the Association, and a number of written communications were read, all of which have been published in the JOURNAL. The Committee has since earnestly sought for other suggestions from those interested in the subject, particularly from experienced pipe inspectors, whose long practice at different foundries has given them an intimate acquaintance with the methods of making cast-iron pipe, and whose suggestions the Committee has found valuable.

The greatest cause of delay in the making of a final report has been the consideration of the subject with a committee which represents, to a large extent, the pipe foundries of the country. This committee began its consideration of the subject soon after the presentation of the report of your Committee on December 11, 1901. Their conclusions and propositions, which were issued in a printed pamphlet, and which are published as an appendix to this report, were not received by your Committee until June 4, 1902. This is not said in any spirit of complaint of the manufacturers' committee, but quite the contrary, as your Committee wishes to express its great satisfaction that the action of this Association in proposing Standard Specifications for cast-iron pipe should be considered a matter of such importance to the manufacturers of pipe that they were willing to spend the time and money necessary for so thorough a study of

* See Preliminary Report of the Committee, with Discussion, on page 85 of the JOURNAL (June, 1902).

the matter among themselves. This fact and the interest shown in our action by other associations of a like nature to our own, not only in this country but in England, that through their representatives have given the Committee their assurance of a willingness and desire to coöperate with us, has been of great encouragement to your Committee to persevere when at times its success in finally attaining a satisfactory result seemed uncertain.

After receiving the report of the committee of the pipe manufacturers and giving it careful consideration, a conference was arranged with a sub-committee consisting of Messrs. Walter Wood, L. R. Lemoine, A. H. McNeal, G. J. Long, A. C. Overholt. These gentlemen met your Committee in Boston, coming here twice for that purpose. Altogether we had four sessions of several hours each, spent in discussing all of the points relating to the manufacture of pipe and the bearing of the different clauses of the proposed specifications upon them.

In these conferences each committee naturally looked at the subject from its own point of view, on one side the manufacturers seeking to provide for the practice that would occasion the fewest difficulties in the foundries and secure a minimum of cost in the product, so far as consistent with good quality; on the other, your Committee seeking to secure the best possible pipe, made in a way to give the least trouble in its use, also at the lowest cost compatible with these requirements. The several points were very fully discussed, and it is the belief of your Committee that the net result was an endeavor to eliminate such requirements as would result in excessive cost of manufacture without a corresponding increase in quality of the pipe or facility in its use, and to retain all requirements tending to secure actual benefits to the users of pipe, your Committee believing that the consumers can well afford to pay any small difference in cost which may be necessary to secure such benefits.

While your Committee conceded some of the changes in the preliminary specifications asked for by the manufacturers, and met them part way on other points, there were still a few which it did not feel that it was wise to change and upon which it cannot be said that the conference came to an entire agreement. It is hoped, however, that these points of difference will not stand in the way of a cordial acceptance of the specifications by the manufacturers, and that they will be adopted as the basis of general practice in the manufacture

of stock pipe, as it was intimated that they would be, if an agreement was reached.

The provision of the specifications which caused the most debate was the one which was perhaps the most favorably commented upon by those of our members taking part in the discussion already published in the JOURNAL, namely, the proposition to make all pipe of the same nominal size, of a uniform outside diameter. It seemed to the Committee that this change would be acceptable to the manufacturers on account of the reduction in the number of patterns required. During the consideration of this subject in the conference referred to, it was made clear to your Committee that the saving in the patterns for the outside of the pipe was a small matter compared with the vastly increased number of fittings which would be required for the casting of the inside of the socket of the pipe where the inside diameter varies with each class. There was besides a danger that the pipes would be of poor quality if too great difference in the thickness of the pipe were made by increasing the thickness of the clay on the core.

It would require too much space to explain this matter in detail here, but your Committee became fully satisfied that, in order to secure uniformly good pipe without a large increase in cost, it would be necessary to modify the design of the pipe as given in tables Nos. 1 and 2 of the preliminary specifications. Wishing to retain the advantages of a single class of special castings for all of the classes of the smaller sizes of pipe, and the possibility of using the pipe interchangeably, it has revised tables Nos. 1 and 2 in such a manner that there are two patterns of outside diameter for all sizes of pipe from four inches to sixteen inches inclusive, with one class of special castings; three patterns for all sizes of pipe from eighteen inches to sixty inches inclusive, with two classes of special castings for sizes eighteen inches to twenty-four inches inclusive, one for the light and ordinary weights of pipe and another for the heavier weights, and three classes of special castings for the larger sizes.

The different classes for each pattern are obtained by making the outside diameter equal to the nominal diameter plus twice the thickness of the heaviest class of that pattern, and the pipe of the heaviest class have the inside diameter equal to the nominal diameter and a uniform thickness from end to end. The lighter classes are obtained by reducing the thickness of the shell on the inside, except at the extreme ends, where it is to be the same as in the heaviest

class and tapered to meet the thinner portion of the body of the pipe through a length of six inches.

It may be said that this design will result in a pipe line for the lighter classes which is not uniform in inside diameter from end to end. The Committee have considered this matter of the enlargement of the body of the pipe, and, in view of the many uncertain conditions which necessarily exist in all pipe lines, especially when they are not new, is of the opinion that the effect is inconsiderable and, whatever it may be, is on the side of increased capacity. In any event, this method of manufacture is the only practicable one, in the opinion of your Committee, by which pipes can be made which are interchangeable and which can be used satisfactorily with one pattern of special casting up to sixteen inches in diameter.

NOTE. — It may be said in reply to the last statement that some cities are having all of their pipes cast with uniform outside diameters. This is true, and attention is called to the fact that the range of weight or thickness used by any single city is much narrower than that provided for in the tables of these specifications, which are designed to meet the requirements of all users of water pipes, and necessarily cover what some consider very light pipe and what others consider very heavy. The Committee believes this range of design to be necessary, and wishes to emphasize its conviction that it is not the province of Standard Specifications to dictate engineering design.

To use one pattern of special castings with two patterns of pipe, the joint room for the larger pattern is made a little thinner than the standard joint of the pipes and a little thicker for the smaller pattern. No joint room, however, is less than .35 of an inch, and none exceeds .60 of an inch. As the special castings occur only occasionally in the line, the above variation in joint room cannot be a serious matter, particularly when we consider past experience in this respect.

All suggestions made in the discussion of the subject have been carefully considered by your Committee, and many of them incorporated in the final form of the specifications now presented. These may be readily found by comparison with the preliminary specifications, as well as the changes made at the request of the manufacturers' committee, and it seems unnecessary to occupy time and space to refer to them in detail.

So much time has been occupied in the consideration of the specifications that your Committee was not able to submit at the present

time tables showing the design and standard weights of the several classes and patterns of special castings.

In general design the special castings recommended are of the pattern now used on the Metropolitan Water Works. If these specifications are adopted by the Association, tables giving the dimensions and weight of every special casting required in ordinary practice will be prepared by your Committee, to be published with the specifications in their final form.

Respectfully submitted,

FREEMAN C. COFFIN,
DEXTER BRACKETT,
F. F. FORBES,
Committee on Standard Specifications for Cast-Iron Pipe.

NOTE. — Many of these tables have since been prepared and are now printed with the specifications. The remainder of the tables are expected to be ready for publication in the next issue of the JOURNAL. The specifications with the complete tables will then be reprinted, and will be for sale by the Secretary.

DECEMBER 1, 1902.

PROPOSED SPECIFICATIONS.

NEW ENGLAND WATER WORKS ASSOCIATION STANDARD SPECIFICATIONS FOR CAST-IRON PIPE.

Description of Pipes.

SECTION 1. The pipes shall be made with hub and spigot joints, and shall accurately conform to the dimensions given in tables Nos. 1 and 2. They shall be straight and shall be true circles in section, with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter. They shall be at least twelve feet in length, exclusive of socket. For pipes of each size from 4 inches to 16 inches in diameter there shall be two standards, and for each larger size three standards of outside diameter. The inside diameter of each class shall be increased from the nominal size in the manner hereinafter specified, so as to obtain the standard thickness and weight. For pipes from 4 inches to 16 inches in diameter one class of special castings shall be furnished with all classes of pipes. For pipes from 18 inches to 24 inches in diameter, Class D special castings shall be furnished with pipes of Classes A, B, C, and D, and Class F special castings with pipes of Classes E and F. For pipes 30 inches in diameter and larger, Class B special castings shall be used with pipes of Classes A and B, Class D special castings with pipes of Classes C and D, and Class F special castings with pipes of Classes E and F.

All pipes having the same outside diameter shall have the same inside diameter at both ends. The inside diameter of the lighter pipes of each standard outside diameter shall be gradually increased for a distance of six inches from each end of the pipe, so as to obtain the required standard thickness and weight for each size and class of pipe.

Allowable Variation in Diameter of Pipes and Sockets.

SECT. 2. Especial care shall be taken to have the sockets of the required size. The sockets and spigots will be tested by circular

gages, and no pipe will be received which is defective in joint-room from any cause. The diameters of the sockets and the outside diameters of the spigot ends of the pipes shall not vary from the standard dimensions by more than .06 of an inch for pipes 16 inches or less in diameter; .08 of an inch for 18-inch, 20-inch, and 24-inch pipes; .10 of an inch for 30-inch, 36-inch, and 42-inch pipes, and .12 of an inch for 48-inch, 54-inch, and 60-inch pipes.

Allowable Variation in Thickness.

SECT. 3. For pipes whose standard thickness is less than one inch, the thickness of metal in the body of the pipe shall not be more than .08 of an inch less than the standard thickness, and for pipes whose standard thickness is one inch or more, the variation shall not exceed .10 of an inch, except that for spaces not exceeding eight inches in length in any direction, variations from the standard thickness of .02 of an inch in excess of the allowances above given shall be permitted.

Defective Spigots may be Cut.

SECT. 4. Defective spigot ends on pipes twelve inches or more in diameter may be cut off in a lathe, and a half-round wrought-iron band shrunk into a groove cut in the end of the pipe. Not more than twelve per cent. of the total number of accepted pipes of each size shall be cut and banded, and no pipe shall be banded which is less than eleven feet in length, exclusive of the socket.

In case the length of a pipe differs from twelve feet, the standard weight of the pipe given in Table No. 2 shall be modified in accordance therewith.

Special Castings.

SECT. 5. All special castings shall be made in accordance with the cuts and the dimensions given in the tables forming a part of these specifications.

The diameters of the sockets and the external diameters of the spigot ends of the special castings shall not vary from the standard dimensions by more than .08 of an inch for castings 16 inches or less in diameter; .10 of an inch for 18-inch, 20-inch, and 24-inch pipes; .13 of an inch for 30-inch, 36-inch, and 42-inch pipes, and .16 of an inch for 48-inch, 54-inch, and 60-inch pipes.

The flanges on all manhole castings and manhole covers shall be

faced true and smooth, and drilled to receive bolts of the sizes given in the tables. The contractor shall furnish and deliver all bolts for bolting on the manhole covers, the bolts to be of the sizes shown on plans, and made of the best quality of mild steel, with hexagonal heads and nuts, and sound, well-fitting threads.

Marking.

SECT. 6. Every pipe and special casting shall have distinctly cast upon it the initials of the maker's name. When cast especially to order, each pipe and special casting shall also have cast upon it figures showing the year in which it was cast and a number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below; thus, —

1901	1901	1901
1	2	3

etc., also any initials, not exceeding four, which may be required by the purchaser. The letters and figures shall be cast on the outside and shall be not less than two inches in length and one-eighth of an inch in relief for pipes eight inches in diameter and larger. For smaller sizes of pipes the letters may be one inch in length. The weight and the class letter shall be conspicuously painted in white on the inside of each pipe and special casting after the coating has become hard.

Allowable Percentage of Variation in Weight.

SECT. 7. No pipe shall be accepted the weight of which shall be less than the standard weight by more than five per cent. for pipes sixteen inches or less in diameter, and four per cent. for pipes more than sixteen inches in diameter; and no excess above the standard weight of more than the given percentages for the several sizes shall be paid for. The total weight to be paid for shall not exceed for each size and class of pipe received the sum of the standard weights of the same number of pieces of the given size and class by more than two per cent.

No special casting shall be accepted the weight of which shall be less than the standard weight by more than ten per cent. for pipes twelve inches or less in diameter and eight per cent. for larger sizes; and no excess above the standard weight of more than the above percentages for the several sizes will be paid for.

Quality of Iron.

SECT. 8. All pipes and special castings shall be made of cast iron of good quality, and of such character as shall make the metal of the castings strong, tough, and of even grain, and soft enough to satisfactorily admit of drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace.

Tests of Material.

SECT. 9. Specimen bars of the metal used, each being 26 inches long by 2 inches wide and 1 inch thick, shall be made without charge as often as the engineer may direct, and in default of definite instructions the contractor shall make and test at least one bar from each heat or run of metal. The bars, when placed flatwise upon supports 24 inches apart and loaded in the center, shall for pipes 12 inches or less in diameter support a load of 1 900 pounds and show a deflection of not less than .30 of an inch before breaking, and for pipes of sizes larger than 12 inches shall support a load of 2 000 pounds and show a deflection of not less than .32 of an inch. The contractor shall have the right to make and break three bars from each heat or run of metal, and the test shall be based upon the average results of the three bars. Should the dimensions of the bars differ from those above given, a proper allowance therefor shall be made in the results of the tests.

Casting of Pipes.

SECT. 10. The straight pipes shall be cast in dry sand molds in a vertical position. Pipes sixteen inches or less in diameter shall be cast with the hub end up or down, as specified in the proposal. Pipes eighteen inches or more in diameter shall be cast with the hub end down.

The pipes shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

Quality of Castings.

SECT. 11. The pipes and special castings shall be smooth, free from scales, lumps, blisters, sand holes, and defects of every nature

which, in the opinion of the engineer, unfit them for the use for which they are intended. No plugging or filling will be allowed.

Cleaning and Inspection.

SECT. 12. All pipes and special castings shall be thoroughly cleaned and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust, and approved in these respects by the engineer immediately before being dipped.

Coating.

SECT. 13. Every pipe and special casting shall be coated inside and out with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle, nor with any tendency to scale off.

Each casting shall be heated to a temperature of 300° Fahrenheit immediately before it is dipped, and shall possess not less than this temperature at the time it is put in the vat. The ovens in which the pipes are heated shall be so arranged that all portions of the pipe shall be heated to an even temperature. Each casting shall remain in the bath at least five minutes.

The varnish shall be heated to a temperature of 300° Fahrenheit (or less, if the engineer shall so order), and shall be maintained at this temperature during the time the casting is immersed.

Fresh pitch and oil shall be added when necessary to keep the mixture at the proper consistency, and the vat shall be emptied of its contents and refilled with fresh pitch when deemed necessary by the engineer. After being coated, the pipes shall be carefully drained of the surplus varnish. Any pipe or special casting that is to be recoated shall first be thoroughly scraped and cleaned.

Hydrostatic Test.

SECT. 14. When the coating has become hard, the straight pipes shall be subjected to a proof by hydrostatic pressure, and, if required by the engineer, they shall also be subjected to a hammer test under this pressure.

The pressures to which the different sizes and classes of pipes shall be subjected are as follows: —

	20-inch Diameter and Larger. Pounds per Sq. In.	Less than 20-inch Diameter. Pounds per Sq. In.
Class A pipe	150	300
Class B pipe	200	300
Class C pipe	250	300
Class D pipe	300	300
Classes E to K pipe, inclusive	350	350

Weighing.

SECT. 15. The pipes and special castings shall be weighed for payment under the supervision of the engineer, after the application of the coal-tar pitch varnish. If desired by the engineer, the pipes and special castings shall be weighed after their delivery, and the weights so ascertained shall be used in the final settlement, provided such weighing is done by a legalized weighmaster. Bids shall be submitted and a final settlement made upon the basis of a ton of two thousand pounds.

Contractor to Furnish Men and Materials.

SECT. 16. The contractor shall provide all tools, testing machines, materials, and men necessary for the required testing, inspection, and weighing at the foundry of the pipes and special castings; and should the purchaser have no inspector at the works, the contractor shall, if required by the engineer, furnish a sworn statement that all of the tests have been made as specified, this statement to contain the results of the transverse tests upon the test bars.

Power of the Engineer to Inspect.

SECT. 17. The engineer shall be at liberty at all times to inspect the material at the foundry, and the molding, casting, and coating of the pipes and special castings. The forms, sizes, uniformity, and conditions of all pipes and other castings herein referred to shall be subject to his inspection and approval, and he may reject, without

proving, any pipe or other casting which is not in conformity with the specifications or drawings furnished.

Inspector to Report.

SECT. 18. The inspector at the foundry shall report daily to the foundry office all pipes and special castings rejected, with the causes for rejection.

Castings to be Delivered Sound and Perfect.

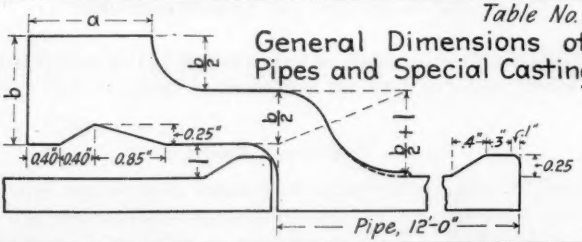
SECT. 19. All the pipes and other castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the contractor of any of his obligations in this respect, and any defective pipe or other casting which may have passed the engineer at the works or elsewhere shall be at all times liable to rejection when discovered, until the final completion and adjustment of the contract, provided, however, that the contractor shall not be held liable for pipes or special castings found to be cracked after they have been accepted at the agreed point of delivery. Care shall be taken in handling the pipes not to injure the coating, and no pipes or other material of any kind shall be placed in the pipes during transportation or at any time after they receive the coating.

Definition of the Word "Engineer."

SECT. 20. Wherever the word "engineer" is used herein, it shall be understood to refer to the engineer or inspector acting for the purchaser, and to his properly authorized agents, limited by the particular duties intrusted to them.

Table No. 1

General Dimensions of Pipes and Special Castings.



Nominal Diam. INCHES	Classes	Actual Outside Diam. INCHES	DIAM. OF SOCKETS Pipe INCHES	DIAM. OF SOCKETS Special Castings INCHES	DEPTH OF SOCKETS Pipe INCHES	DEPTH OF SOCKETS Special Castings INCHES	"a"	"b"
4	A,C,E	4.80	5.60	5.70	3.00	4.00	1.50	1.30
"	G,I,K	5.00	5.80	"	"	"	"	"
6	A,C,E	6.90	7.77	7.80	"	"	"	1.40
"	G,I	7.10	7.90	"	"	"	"	"
8	A,C,E	9.05	9.85	10.00	3.50	"	"	1.50
"	G,I	9.30	10.10	"	"	"	"	"
10	A,B,C,D	11.10	11.90	12.10	"	4.50	"	"
"	E,F,G,H	11.40	12.20	"	"	"	"	"
12	A,B,C,D	13.20	14.00	14.20	"	"	"	1.60
"	E,F,G,H	13.50	14.30	"	"	"	"	"
14	A,B,C,D	15.30	16.10	16.35	"	"	"	1.70
"	E,F,G,H	15.65	16.45	"	"	"	"	"
16	A B C D	17.40	18.40	18.60	4.00	5.00	1.75	1.80
"	E,F,G,H	17.80	18.80	"	"	"	"	"
18	A,B,	19.25	20.25	20.40	"	"	"	1.90
"	C,D	19.50	20.50	"	"	"	"	"
"	E,F	19.70	20.70	20.70	"	"	"	"
20	A,B	21.30	22.30	22.50	"	"	"	2.00
"	C,D	21.60	22.60	"	"	"	"	"
"	E,F	21.90	22.90	23.00	"	"	"	"
24	A,B	25.40	26.40	26.60	"	"	2.00	2.10
"	C,D	25.80	26.80	"	"	"	"	"
"	E,F	26.10	27.10	27.10	"	"	"	"
30	A,B	31.60	32.60	32.60	4.50	"	"	2.30
"	C,D	32.00	33.00	33.00	"	"	"	"
"	E,F	32.40	33.40	33.40	"	"	"	"
36	A,B	37.80	38.80	38.80	"	"	"	2.50
"	C,D	38.30	39.30	39.30	"	"	"	"
"	E,F	38.70	39.70	39.70	"	"	"	"
42	A,B	44.00	45.00	45.00	5.00	"	"	2.80
"	C,D	44.50	45.50	45.50	"	"	"	"
"	E,F	45.10	46.10	46.10	"	"	"	"
48	A,B	50.20	51.20	51.20	"	"	"	3.00
"	C,D	50.80	51.80	51.80	"	"	"	"
"	E,F	51.40	52.40	52.40	"	"	"	"
54	A,B	56.40	57.40	57.40	5.50	5.50	2.25	3.20
"	C,D	57.10	58.10	58.10	"	"	"	"
"	E,F	57.80	58.80	58.80	"	"	"	3.80
60	A,B	62.60	63.60	63.60	"	"	"	3.40
"	C,D	63.40	64.40	64.40	"	"	"	"
"	E,F	64.20	65.20	65.20	"	"	"	4.00

TABLE No. 2

Standard Thicknesses and Weights of Cast Iron Pipes

12 feet in length exclusive of socket

Nominal Diameter of Pipe	Class A		Class B		Class C		Class D		Class E		Class F		Class G		Class H		Class I		Class K	
	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS	Thickness of Shell INCHES	Weight per Length POUNDS
4	.34	200			.36	215			.39	230			.42	250			.45	265	.48	280
6	.38	330			.42	350			.46	380			.50	420			.54	445		
8	.42	475			.48	530			.53	575			.58	640			.63	690		
10	.47	650	.50	680	.53	720	.56	760	.60	810	.63	850	.67	890	.70	935				
12	.49	810	.53	855	.57	910	.61	970	.65	1040	.69	1100	.73	1160	.77	1220				
14	.53	1010	.57	1080	.61	1150	.66	1220	.70	1310	.75	1390	.79	1460	.83	1530				
16	.55	1215	.60	1300	.65	1390	.70	1490	.75	1610	.80	1710	.85	1810	.90	1900				
18	.57	1400	.63	1520	.69	1660	.75	1780	.80	1910	.86	2040								
20	.60	1610	.66	1760	.72	1920	.79	2090	.85	2260	.92	2420								
24	.64	2050	.72	2290	.80	2550	.88	2780	.95	3000	1.03	3240								
30	.71	2860	.81	3230	.91	3600	1.01	3950	1.10	4340	1.20	4700								
36	.79	3800	.90	4270	1.02	4840	1.13	5310	1.25	5900	1.37	6400								
42	.87	4920	1.00	5560	1.13	6270	1.27	6970	1.40	7720	1.53	8360								
48	.95	6130	1.10	6970	1.25	7920	1.40	8780	1.55	9740	1.70	10600								
54	1.03	7510	1.20	8600	1.37	9800	1.54	10900	1.72	12400	1.90	13500								
60	1.10	8900	1.30	10300	1.50	11900	1.70	13300	1.90	15100	2.10	16500								

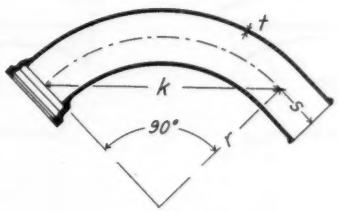
Table No. 3

Straight Pipes
Standard Weights per foot
(exclusive of sockets)

Nominal Diam.	Class	Weight per foot in lbs.	Nominal Diam.	Class	Weight per foot in lbs.	Nominal Diam.	Class	Weight per foot in lbs.
4	A	14.89	14	C	87.97	30	C	277.7
"	C	15.70	"	D	94.85	"	D	307.3
"	E	16.92	"	E	102.73	"	E	338.0
"	G	18.89	"	F	109.70	"	F	367.5
"	I	20.10	"	G	115.24	36	A	287.0
"	K	21.30	"	H	120.74	"	B	326.0
6	A	24.32	16	A	90.98	"	C	373.3
"	C	26.72	"	B	98.95	"	D	412.3
"	E	29.08	"	C	106.9	"	E	459.6
"	G	32.40	"	D	114.8	"	F	502.0
"	I	34.79	"	E	125.5	42	A	368.4
8	A	35.58	"	F	133.5	"	B	422.1
"	C	40.38	"	G	141.4	"	C	481.1
"	E	44.33	"	H	149.3	"	D	538.9
"	G	49.65	18	A	104.5	"	E	600.6
"	I	53.62	"	B	115.2	"	F	654.4
10	A	49.04	"	C	127.4	48	A	459.3
"	B	52.03	"	D	138.0	"	B	530.2
"	C	54.99	"	E	148.4	"	C	608.0
"	D	57.94	"	F	159.0	"	D	678.9
"	E	63.61	20	A	121.9	"	E	758.5
"	F	66.61	"	B	133.7	"	F	829.4
"	G	70.57	"	C	147.6	54	A	559.8
"	H	73.53	"	D	161.4	"	B	650.3
12	A	61.14	"	E	175.6	"	C	749.5
"	B	65.92	"	F	189.5	"	D	839.9
"	C	70.67	24	A	155.6	"	E	946.9
"	D	75.39	"	B	174.4	"	F	1042.7
"	E	81.99	"	C	196.3	60	A	664.0
"	F	86.77	"	D	215.3	"	B	782.3
"	G	91.51	"	E	234.5	"	C	911.5
"	H	96.22	"	F	253.5	"	D	1029.7
14	A	76.85	30	A	215.3	"	E	1162.0
"	B	82.41	"	B	244.8	"	F	1280.0

Table No. 4

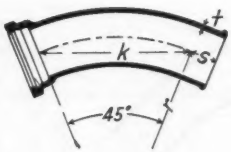
¼ Curves



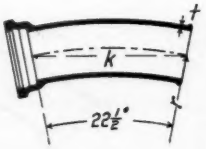
Nominal Diam.	Class	Dimensions in inches				Weight	
		t	r	k	s		
4	K	48	16	22.6	8	80	
6	I	54	"	"	"	130	
8	"	.63	"	"	10	200	
10	H	.70	"	"	12	290	
12	"	.77	"	"	"	375	
14	"	.83	18	25.5	"	500	
16	"	.90	24	34.0	"	740	
18	D	.75	"	"	"	715	
"	F	.86	"	"	"	805	
20	D	79	"	"	"	835	
"	F	.92	"	"	"	950	
24	D	.88	30	42.4	"	1275	
"	F	1.03	"	"	"	1470	
30	B	.81	36	50.9	"	1690	
"	D	1.01	"	"	"	2050	
"	F	1.20	"	"	"	2400	
36	B	.90	48	67.9	"	2750	
"	D	1.13	"	"	"	3380	
"	F	1.37	"	"	"	4040	

Table No. 5

1/8 Curves



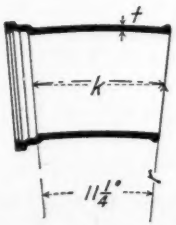
1/16 Curves



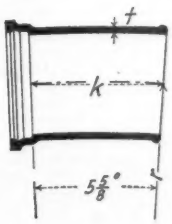
Nominal Diam.	Class	t	1/8 Curves				1/16 Curves		
			r	k	s	Weight	r	k	Weight
4	K	.48	24	18.4	4	65	48	18.7	55
6	I	.54	"	"	"	100	"	"	90
8	"	.63	"	"	"	150	"	"	130
10	H	.70	"	"	"	200	"	"	175
12	"	.77	"	"	"	260	"	"	225
14	"	.83	36	27.6		375	72	28.1	375
16	"	.90	"	"		475	"	"	475
18	D	.75	"	"		470	"	"	470
"	F	.86	"	"		520	"	"	520
20	D	.79	48	36.7		675	96	37.5	675
"	F	.92	"	"		765	"	"	765
24	D	.88	60	45.9		1060	120	46.8	1060
"	F	1.03	"	"		1210	"	"	1210
30	B	.81	"	"		1250	"	"	1250
"	D	1.01	"	"		1500	"	"	1500
"	F	1.20	"	"		1740	"	"	1740
36	B	.90	90	68.9		2300	180	70.2	2300
"	D	1.13	"	"		2810	"	"	2810
"	F	1.37	"	"		3350	"	"	3350
42	B	1.00	"	"		2980	"	"	2980
"	D	1.27	"	"		3680	"	"	3680
"	F	1.53	"	"		4370	"	"	4370
48	B	1.10	"	"		3740	"	"	3740
"	D	1.40	"	"		4620	"	"	4620
"	F	1.70	"	"		5510	"	"	5510
54	B	1.20	"	"		4630	"	"	4630
"	D	1.54	"	"		5750	"	"	5750
"	F	1.90	"	"		7170	"	"	7170
60	B	1.30	"	"		5550	"	"	5550
"	D	1.70	"	"		7020	"	"	7020
"	F	2.10	"	"		8720	"	"	8720

Table No. 6

1/32 Curves



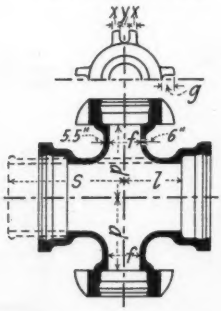
1/64 Curves



Nominal Diam.	Class	t	1/32 Curves			1/64 Curves		
			r	k	Weight	r	k	Weight
20	D	.72	240	47.05	750	480	47.10	750
"	F	.92	"	"	920	"	"	920
24	D	.88	"	"	1060	"	"	1060
"	F	1.03	"	"	1215	"	"	1215
30	B	.81	"	"	1250	"	"	1250
"	D	1.01	"	"	1500	"	"	1500
"	F	1.20	"	"	1740	"	"	1740
36	B	.90	"	"	1660	"	"	1660
"	D	1.13	"	"	2000	"	"	2000
"	F	1.37	"	"	2360	"	"	2360
42	B	1.00	"	"	2150	"	"	2150
"	D	1.27	"	"	2620	"	"	2620
"	F	1.53	"	"	3080	"	"	3080
48	B	1.10	"	"	2700	"	"	2700
"	D	1.40	"	"	3300	"	"	3300
"	F	1.70	"	"	3900	"	"	3900
54	B	1.20	"	"	3350	"	"	3350
"	D	1.54	"	"	4110	"	"	4110
"	F	1.90	"	"	5100	"	"	5100
60	B	1.30	"	"	4000	"	"	4000
"	D	1.70	"	"	5000	"	"	5000
"	F	2.10	"	"	6200	"	"	6200

Table No. 7

Branches



Dimensions in Inches									Weight			
Nom. Diam	f	l	s	p	x	y	g	Class	3 way Branch		4 way Branch	
									2 bells	3 bells	3 bells	4 bells
4	4	11	23	11				K	125	130	155	160
6	"	12	24	12				I	170	170	205	205
"	6	"	"	"				"	190	190	240	240
8	4	13	25	13				"	250	240	285	275
"	6	"	"	"				"	275	260	325	310
"	8	"	"	"				"	290	280	370	360
10	4	14	26	14				H	340	325	375	360
"	6	"	"	"				"	360	340	410	390
"	8	"	"	"				"	380	360	450	435
"	10	"	"	"				"	405	390	505	490
12	4	15	27	15				"	450	425	490	460
"	6	"	"	"				"	470	440	510	485
"	8	"	"	"				"	485	460	555	530
"	10	"	"	"				"	510	490	605	575
"	12	"	"	"	1.25	1.62	2.50	"	570	540	710	680
14	4	16	28	16				"	570	540	610	580
"	6	"	"	"				"	590	560	635	605
"	8	"	"	"				"	610	580	675	645
"	10	"	"	"				"	630	600	720	690
"	12	"	"	"	"	"	"	"	685	655	825	795
"	14	"	"	"	"	"	"	"	715	685	895	860
16	4	17	29	17				"	735	705	770	740
"	6	"	"	"				"	750	715	790	760
"	8	"	"	"				"	765	735	830	800
"	10	"	"	"				"	790	760	875	845
"	12	"	"	"	"	"	"	"	835	805	975	945
"	14	"	"	"	"	"	"	"	865	835	1040	1010
"	16	"	"	"	"	"	"	"	935	905	1170	1140
18	4	18	30	18				D	725	730	760	760
"	"	"	"	"				F	810	795	845	825
"	6	"	"	"				D	745	745	790	790
"	"	"	"	"				F	830	810	875	860
"	8	"	"	"				D	765	765	830	830

Table No. 7
(continued)

Branches

Dimensions in Inches									Weight			
									3 way Branch		4 way Branch	
Nom. Diam	f	l	s	p	x	y	g	Class	2 bells	3 bells	3 bells	4 bells
18	8	18	30	18				F	850	830	915	895
"	10	"	"	"				D	785	785	875	880
"	"	"	"	"				F	870	850	955	940
"	12	"	"	"	1.25	1.62	2.50	D	845	845	990	990
"	"	"	"	"	"	"	"	F	925	905	1070	1050
"	14	"	"	"	"	"	"	D	875	875	1050	1060
"	"	"	"	"	"	"	"	F	955	935	1130	1110
"	16	"	"	"	"	"	"	D	945	945	1200	1200
"	"	"	"	"	"	"	"	F	1020	1010	1260	1250
"	18	"	"	"	"	"	"	D	945	945	1200	1200
"	"	"	"	"	"	"	"	F	1040	1030	1310	1290
20	6	19	31	19				D	895	895	935	935
"	"	"	"	"				F	1010	990	1055	1030
"	8	"	"	"				D	905	905	975	975
"	"	"	"	"				F	1030	1010	1090	1070
"	10	"	"	"				D	935	935	1020	1020
"	"	"	"	"				F	1050	1025	1135	1110
"	12	"	"	"	"	"	"	D	975	975	1110	1110
"	"	"	"	"	"	"	"	F	1090	1070	1220	1200
"	14	"	"	"	"	"	"	D	1005	1005	1170	1170
"	"	"	"	"	"	"	"	F	1120	1100	1280	1255
"	16	"	"	"	"	"	"	D	1055	1055	1260	1260
"	"	"	"	"	"	"	"	F	1185	1160	1400	1375
"	18	"	"	"	"	"	"	D	1080	1090	1330	1330
"	"	"	"	"	"	"	"	F	1220	1190	1470	1450
"	20	"	"	"	"	"	"	D	1125	1125	1400	1400
"	"	"	"	"	"	"	"	F	1260	1235	1560	1535
24	6	21	33	21				D	1240	1230	1280	1270
"	"	"	"	"				F	1410	1370	1460	1420
"	8	"	"	"				D	1250	1240	1310	1300
"	"	"	"	"				F	1430	1390	1490	1450
"	10	"	"	"				D	1280	1270	1360	1360
"	"	"	"	"				F	1450	1410	1520	1490
"	12	"	"	"	"	"	"	D	1320	1310	1450	1450
"	"	"	"	"	"	"	"	F	1490	1450	1610	1580
"	14	"	"	"	"	"	"	D	1350	1340	1510	1500
"	"	"	"	"	"	"	"	F	1510	1470	1660	1630
"	16	"	"	"	"	"	"	D	1410	1400	1630	1620
"	"	"	"	"	"	"	"	F	1570	1530	1780	1740
"	18	"	"	"	"	"	"	D	1420	1410	1650	1640
"	"	"	"	"	"	"	"	F	1600	1550	1830	1790
"	20	"	"	"	"	"	"	D	1460	1450	1720	1710
"	"	"	"	"	"	"	"	F	1650	1610	1920	1880

Table No. 7
(continued)

Branches

Dimensions in Inches									Weight			
									3 way Branch		4 way Branch	
Nom. Diam.	f	l	s	p	x	y	g	Class	2 bells	3 bells	3 bells	4 bells
24	24	21	33	21	1.25	1.62	2.50	D	1530	1520	1870	1860
"	"	"	"	"	"	"	"	F	1730	1690	2090	2040
30	12	15	27	24	"	"	"	B	1280	1310	1400	1440
"	"	"	"	"	"	"	"	D	1500	1480	1630	1610
"	"	"	"	"	"	"	"	F	1710	1630	1830	1750
"	14	16	28	"	"	"	"	B	1350	1380	1490	1530
"	"	"	"	"	"	"	"	D	1580	1560	1740	1710
"	"	"	"	"	"	"	"	F	1790	1720	1930	1860
"	16	17	29	"	"	"	"	B	1450	1480	1640	1680
"	"	"	"	"	"	"	"	D	1690	1670	1890	1870
"	"	"	"	"	"	"	"	F	1910	1830	2100	2020
"	18	18	32	"	"	"	"	B	1530	1520	1750	1740
"	"	"	"	"	"	"	"	D	1790	1720	2010	1940
"	"	"	"	"	"	"	"	F	2060	1920	2280	2140
"	20	19	34	"	"	"	"	B	1630	1610	1870	1850
"	"	"	"	"	"	"	"	D	1910	1820	2150	2060
"	"	"	"	"	"	"	"	F	2180	2020	2440	2280
"	24	21	36	"	"	"	"	B	1770	1750	2070	2050
"	"	"	"	"	"	"	"	D	2080	1980	2390	2290
"	"	"	"	"	"	"	"	F	2380	2220	2700	2540
"	30	24	41	"	1.50	2.00	3.00	B	2070	2010	2510	2450
"	"	"	"	"	"	"	"	D	2430	2280	2890	2750
"	"	"	"	"	"	"	"	F	2780	2560	3240	3010
36	12	15	27	27	1.25	1.62	2.50	B	1650	1700	1760	1800
"	"	"	"	"	"	"	"	D	1960	1920	2070	2030
"	"	"	"	"	"	"	"	F	2270	2150	2370	2260
"	14	16	28	"	"	"	"	B	1730	1770	1870	1910
"	"	"	"	"	"	"	"	D	2050	2010	2190	2150
"	"	"	"	"	"	"	"	F	2370	2260	2500	2390
"	16	17	29	"	"	"	"	B	1840	1880	2020	2060
"	"	"	"	"	"	"	"	D	2170	2130	2360	2320
"	"	"	"	"	"	"	"	F	2510	2400	2680	2570
"	18	18	32	"	"	"	"	B	1940	1930	2150	2140
"	"	"	"	"	"	"	"	D	2310	2200	2520	2410
"	"	"	"	"	"	"	"	F	2690	2500	2900	2690
"	20	19	34	"	"	"	"	B	2070	2030	2290	2250
"	"	"	"	"	"	"	"	D	2450	2310	2670	2530
"	"	"	"	"	"	"	"	F	2860	2620	3090	2850
"	24	21	36	"	"	"	"	B	2230	2190	2500	2470
"	"	"	"	"	"	"	"	D	2640	2500	2920	2780
"	"	"	"	"	"	"	"	F	3080	2840	3370	3130
"	30	24	41	"	1.50	2.00	3.00	B	2570	2470	2970	2870
"	"	"	"	"	"	"	"	D	3040	2830	3450	3240

Table No. 7
(continued)

Branches

Dimensions in Inches									Weight			
									3 way Branch		4 way Branch	
Nom. Diam.	f	l	s	p	x	y	g	Class	2 bells	3 bells	3 bells	4 bells
36	30	24	41	27	1.50	2.00	3.00	F	3550	3220	3940	3720
"	36	27	44	"	"	"	"	B	2860	2770	3390	3290
"	"	"	"	"	"	"	"	D	3390	3180	3940	3730
"	"	"	"	"	"	"	"	F	3970	3630	4550	4210
42	12	15	27	30	1.25	1.62	2.50	B	2110	2170	2220	2280
"	"	"	"	"	"	"	"	D	2520	2470	2630	2580
"	"	"	"	"	"	"	"	F	2920	2780	3020	2880
"	14	16	28	"	"	"	"	B	2200	2260	2330	2390
"	"	"	"	"	"	"	"	D	2630	2580	2760	2710
"	"	"	"	"	"	"	"	F	3050	2910	3160	3020
"	16	17	29	"	"	"	"	B	2330	2390	2510	2570
"	"	"	"	"	"	"	"	D	2780	2730	2960	2910
"	"	"	"	"	"	"	"	F	3200	3060	3370	3230
"	18	18	32	"	"	"	"	B	2450	2450	2650	2650
"	"	"	"	"	"	"	"	D	2940	2810	3140	3000
"	"	"	"	"	"	"	"	F	3430	3160	3620	3350
"	20	19	34	"	"	"	"	B	2600	2570	2820	2780
"	"	"	"	"	"	"	"	D	3120	2940	3330	3150
"	"	"	"	"	"	"	"	F	3630	3320	3840	3530
"	24	21	36	"	"	"	"	B	2800	2760	3050	3010
"	"	"	"	"	"	"	"	D	3350	3170	3600	3420
"	"	"	"	"	"	"	"	F	3900	3590	4150	3840
"	30	24	41	"	1.50	2.00	3.00	B	3180	3070	3540	3430
"	"	"	"	"	"	"	"	D	3820	3550	4180	3910
"	"	"	"	"	"	"	"	F	4460	4030	4840	4410
"	36	27	44	"	"	"	"	B	3510	3400	3980	3870
"	"	"	"	"	"	"	"	D	4210	3950	4700	4430
"	"	"	"	"	"	"	"	F	4900	4480	5400	4970
"	42	30	47	"	"	"	"	B	3930	3810	4610	4490
"	"	"	"	"	"	"	"	D	4700	4430	5420	5140
"	"	"	"	"	"	"	"	F	5480	5050	6200	5780
48	16	17	29	33	1.25	1.62	2.50	B	2850	2920	3040	3100
"	"	"	"	"	"	"	"	D	3420	3350	3600	3530
"	"	"	"	"	"	"	"	F	4000	3790	4150	3940
"	18	18	32	"	"	"	"	B	3020	3000	3210	3190
"	"	"	"	"	"	"	"	D	3640	3450	3820	3640
"	"	"	"	"	"	"	"	F	4260	3910	4440	4090
"	20	19	34	"	"	"	"	B	3180	3120	3390	3320
"	"	"	"	"	"	"	"	D	3840	3600	4040	3800
"	"	"	"	"	"	"	"	F	4520	4100	4710	4300
"	24	21	36	"	"	"	"	B	3400	3340	3650	3590
"	"	"	"	"	"	"	"	D	4110	3870	4350	4110
"	"	"	"	"	"	"	"	F	4830	4420	5060	4650

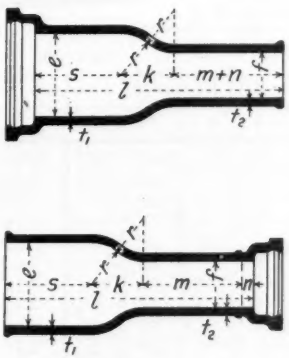
Table No. 7
(concluded)

Branches

Dimensions in Inches									Weight			
									3 way Branch		4 way Branch	
Nom. Diam.	f	l	s	p	x	y	g	Class	2 bells	3 bells	3 bells	4 bells
48	30	24	41	33	1.50	2.00	3.00	B	3850	3700	4200	4050
"	"	"	"	"	"	"	"	D	4650	4300	5000	4650
"	"	"	"	"	"	"	"	F	5480	4930	5810	5250
"	36	27	44	"	"	"	"	B	4210	4060	4640	4490
"	"	"	"	"	"	"	"	D	5100	4750	5510	5160
"	"	"	"	"	"	"	"	F	6000	5440	6410	5850
"	42	30	48	"	"	"	"	B	4720	4520	5310	5120
"	"	"	"	"	"	"	"	D	5680	5280	6300	5900
"	"	"	"	"	"	"	"	F	6670	6040	7280	6650
"	48	33	50	"	"	"	"	B	5100	4950	5870	5720
"	"	"	"	"	"	"	"	D	6150	5800	6950	6600
"	"	"	"	"	"	"	"	F	7220	6670	8050	7490

Table No. 11

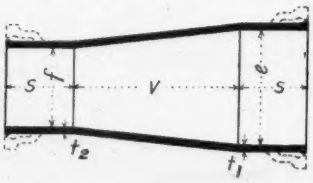
Reducers.–Type I



Dimensions in Inches											Weight	
Nom. diam e	f	s	k	m	n	l	r	t_1	t_2	Class	Bell on Large end	Bell on Small end
6	4	10	3.3	14.7	2	30	3	.54	.48	I	100	90
8	"	"	5.3	12.7	"	"	4	.63	"	"	135	110
"	6	"	3.9	14.1	"	"	"	"	.54	"	150	140
10	4	"	7.1	10.9	"	"	5	.70	.48	H	175	140
"	6	"	6.0	12.0	"	"	"	"	.54	"	190	165
"	8	"	4.4	13.6	"	"	"	"	.63	"	215	200
12	6	"	7.9	10.1	"	"	6	77	.54	"	235	195
"	8	"	6.6	11.4	"	"	"	"	.63	"	255	230
"	10	"	4.8	13.2	"	"	"	"	.70	"	285	270

Table No. 12

Reducers – Type 2



Dimensions in Inches							Weight		
Nom. Diam.		V	S	t_1	t_2	Class	Spigot ends	Bell on Large end	Bell on Small end
e	f								
14	6	20	8	83	.54	H	230	275	250
"	8	"	"	"	.63	"	260	305	285
"	10	"	"	"	.70	"	290	335	320
"	12	"	"	"	.77	"	330	370	365
16	6	"	"	90	.54	"	270	330	290
"	8	"	"	"	63	"	300	360	330
"	10	"	"	"	.70	"	335	390	365
"	12	"	"	"	.77	"	370	425	405
"	14	"	"	"	.83	"	410	465	450
18	8	"	"	75	.63	D	285	370	315
"	"	"	"	.86	"	F	315	390	340
"	10	"	"	.75	.70	D	320	400	350
"	"	"	"	.86	"	F	350	420	380
"	12	"	"	.75	.75	D	355	435	390
"	"	"	"	.86	.77	F	385	460	420
"	14	"	"	.75	.75	D	375	455	420
"	"	"	"	.86	.83	F	425	500	465
"	16	"	"	.75	.75	D	395	480	465
"	"	"	"	.86	.86	F	460	535	520
20	10	26	"	.79	.70	D	410	505	440
"	"	"	"	.92	"	F	455	545	485
"	12	"	"	.79	77	D	455	550	490
"	"	"	"	.92	"	F	500	585	535
"	14	"	"	.79	79	D	490	580	530
"	"	"	"	.92	83	F	545	630	590
"	16	"	"	.79	.79	D	515	610	580
"	"	"	"	.92	90	F	595	685	655
"	18	"	"	.79	75	D	530	625	610
"	"	"	"	.92	.86	F	615	700	690
24	14	"	"	.88	.83	D	590	710	635
"	"	"	"	1.03	"	F	650	760	695
"	16	"	"	.88	.88	D	640	755	695
"	"	"	"	1.03	.90	F	705	815	765
"	18	"	"	.88	.75	D	620	740	700
"	"	"	"	1.03	.86	F	725	830	800
"	20	"	"	.88	.79	D	665	785	760
"	"	"	"	1.03	.92	F	780	885	865
30	18	"	"	81	.75	B	675	855	755

Table No. 12
(continued)

Reducers.–Type 2

Dimensions in Inches							Weight		
Nom. Diam. e	f	v	s	t_1	t_2	Class	Spigot ends	Bell on Large end	Bell on Small end
30	18	26	8	1.01	.75	D	775	930	855
"	"	"	"	1.20	.86	F	910	1050	985
"	20	"	"	.81	.79	B	715	895	810
"	"	"	"	1.01	"	D	820	975	910
"	"	"	"	1.20	.92	F	970	1110	1100
"	24	"	"	.81	.81	B	780	960	940
"	"	"	"	1.01	.88	D	920	1080	1040
"	"	"	"	1.20	1.03	F	1090	1230	1200
36	20	32	"	.90	.79	B	975	1210	1070
"	"	"	"	1.13	"	D	1130	1330	1220
"	"	"	"	1.37	.92	F	1360	1530	1450
"	24	"	"	.90	.88	B	1090	1320	1210
"	"	"	"	1.13	"	D	1250	1450	1370
"	"	"	"	1.37	1.03	F	1500	1670	1610
"	30	"	"	.90	.81	B	1150	1380	1330
"	"	"	"	1.13	1.01	D	1440	1640	1600
"	"	"	"	1.37	1.20	F	1740	1910	1880
42	20	"	"	1.00	.79	B	1150	1460	1250
"	"	"	"	1.27	"	D	1360	1630	1460
"	"	"	"	1.53	.92	F	1640	1860	1720
"	24	"	"	1.00	.88	B	1270	1580	1390
"	"	"	"	1.27	"	D	1490	1750	1600
"	"	"	"	1.53	1.03	F	1790	2010	1890
"	30	"	"	1.00	.81	B	1330	1640	1510
"	"	"	"	1.27	1.01	D	1690	1950	1850
"	"	"	"	1.53	1.20	F	2040	2260	2170
"	"	66	"	1.00	.81	B	2270	2580	2450
"	"	"	"	1.27	1.01	D	2870	3140	3030
"	"	"	"	1.53	1.20	F	3470	3690	3600
"	36	32	"	1.00	.90	B	1500	1810	1740
"	"	"	"	1.27	1.13	D	1910	2180	2110
"	"	"	"	1.53	1.37	F	2320	2540	2490
"	"	66	"	1.00	.90	B	2560	2870	2790
"	"	"	"	1.27	1.13	D	3250	3520	3460
"	"	"	"	1.53	1.37	F	3950	4180	4120
48	30	32	"	1.10	.81	B	1540	1920	1720
"	"	"	"	1.40	1.01	D	1950	2280	2110
"	"	"	"	1.70	1.20	F	2360	2630	2500
"	"	132	"	1.10	.81	B	4700	5090	4890
"	"	"	"	1.40	1.01	D	5970	6290	6130
"	"	"	"	1.70	1.20	F	7230	7500	7360
"	36	32	"	1.10	.90	B	1710	2090	1940
"	"	"	"	1.40	1.13	D	2180	2500	2390
"	"	"	"	1.70	1.37	F	2650	2920	2820

Table No. 12
(continued)

Reducers.–Type 2

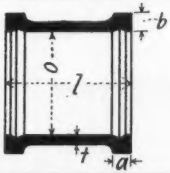
Dimensions in Inches							Weight		
Nom. Diam. d	f	V	S	t_1	t_2	Class	Spigot ends	Bell on Large end	Bell on Small end
48	36	132	8	1.10	.90	B	5250	5630	5480
"	"	"	"	1.40	1.13	D	6700	7020	6900
"	"	"	"	1.70	1.37	F	8140	8410	8310
"	42	32	"	1.10	1.00	B	1910	2290	2220
"	"	"	"	1.40	1.27	D	2440	2770	2710
"	"	"	"	1.70	1.53	F	2970	3240	3200
"	"	132	"	1.10	1.00	B	5880	6260	6190
"	"	"	"	1.40	1.27	D	7510	7840	7780
"	"	"	"	1.70	1.53	F	9140	9410	9370
54	36	66	"	1.20	.90	B	3300	3790	3530
"	"	"	"	1.54	1.13	D	4220	4630	4430
"	"	"	"	1.90	1.37	F	5200	5720	5370
"	"	132	"	1.20	.90	B	5940	6430	6170
"	"	"	"	1.54	1.13	D	7600	8010	7810
"	"	"	"	1.90	1.37	F	9360	9880	9530
"	42	66	"	1.20	1.00	B	3650	4140	3960
"	"	"	"	1.54	1.27	D	4690	5100	4960
"	"	"	"	1.90	1.53	F	5770	6290	6000
"	"	132	"	1.20	1.00	B	6580	7070	6890
"	"	"	"	1.54	1.27	D	8450	8860	8720
"	"	"	"	1.90	1.53	F	10400	10900	10600
"	48	66	"	1.20	1.10	B	4040	4530	4420
"	"	"	"	1.54	1.40	D	5200	5610	5520
"	"	"	"	1.90	1.70	F	6400	6910	6670
"	"	132	"	1.20	1.10	B	7290	7780	7670
"	"	"	"	1.54	1.40	D	9370	9780	9700
"	"	"	"	1.90	1.70	F	11550	12050	11800
60	36	66	"	1.30	.90	B	3710	4280	3940
"	"	"	"	1.70	1.13	D	4810	5280	5010
"	"	"	"	2.10	1.37	F	5940	6520	6110
"	"	132	"	1.30	.90	B	6670	7240	6900
"	"	"	"	1.70	1.13	D	8650	9120	8850
"	"	"	"	2.10	1.37	F	10680	11260	10850
"	42	66	"	1.30	1.00	B	4080	4650	4390
"	"	"	"	1.70	1.27	D	5310	5770	5570
"	"	"	"	2.10	1.53	F	6540	7110	6760
"	"	132	"	1.30	1.00	B	7340	7910	7650
"	"	"	"	1.70	1.27	D	9550	10000	9820
"	"	"	"	2.10	1.53	F	11800	12350	12000
"	48	66	"	1.30	1.10	B	4480	5040	4860
"	"	"	"	1.70	1.40	D	5820	6290	6150
"	"	"	"	2.10	1.70	F	7180	7760	7450
"	"	132	"	1.30	1.10	B	8070	8630	8450
"	"	"	"	1.70	1.40	D	10500	10950	10800

Table No. 12
(concluded)

Reducers.–Type 2

Dimensions in Inches							Weight		
Nom. Diam.									
e	f	v	s	t_1	t_2	Class	Spigot ends	Bell on Large end	Bell on Small end
60	48	132	8	2.10	1.70	F	12950	13500	13200
"	54	66	"	1.30	1.20	B	4900	5470	5390
"	"	"	"	1.70	1.54	D	6400	6860	6810
"	"	"	"	2.10	1.90	F	7940	8520	8460
"	"	132	"	1.30	1.20	B	8840	9400	9330
"	"	"	"	1.70	1.54	D	11550	12000	11950
"	"	"	"	2.10	1.90	F	14300	14900	14850

Table No 13



Sleeves

Nom. Diam.	Class	Dimensions in Inches a	b	l	o	t	Weight
4	K	1.50	1.30	10	5.8	.65	45
6	I	"	1.40	"	7.9	.70	65
8	"	"	1.50	12	10.1	.75	100
10	H	"	"	"	12.2	"	120
12	"	"	1.60	14	14.3	.80	170
14	"	"	1.70	15	16.4	.85	220
16	"	1.75	1.80	"	18.7	.90	275
18	D	"	1.90	"	20.5	.95	315
"	F	"	"	"	20.8	"	320
20	D	"	2.00	"	22.6	1.00	365
"	F	"	"	"	23.1	"	375
24	D	2.00	2.10	"	26.7	1.05	465
"	F	"	"	"	27.2	"	475
30	B	"	2.30	"	32.7	1.15	620
"	D	"	"	"	33.1	"	630
"	F	"	"	"	33.5	"	635
36	B	"	2.50	"	38.9	1.25	805
"	"	"	"	20	"	"	1010
"	D	"	"	15	39.4	"	815
"	"	"	"	20	"	"	1020
"	F	"	"	15	39.8	"	820
"	"	"	"	20	"	"	1030
42	B	"	2.80	15	45.1	1.40	1050
"	"	"	"	20	"	"	1310
"	D	"	"	15	45.6	"	1060
"	"	"	"	20	"	"	1330
"	F	"	"	15	46.2	"	1070
"	"	"	"	20	"	"	1340
48	B	"	3.00	15	51.3	1.50	1280
"	"	"	"	20	"	"	1600
"	D	"	"	15	51.9	"	1290
"	"	"	"	20	"	"	1620
"	F	"	"	15	52.5	"	1300
"	"	"	"	20	"	"	1640
54	B	2.25	3.20	15	57.5	1.60	1570
"	"	"	"	20	"	"	1960
"	D	"	"	15	58.2	"	1590
"	"	"	"	20	"	"	1980
"	F	"	3.80	15	58.9	1.90	1940
"	"	"	"	20	"	"	2410
60	B	"	3.40	15	63.7	1.70	1850
"	"	"	"	20	"	"	2300
"	D	"	"	15	64.5	"	1870
"	"	"	"	20	"	"	2330
"	F	"	4.00	15	65.3	2.00	2260
"	"	"	"	20	"	"	2810

APPENDIX.

Report of the Foundry Committee.

January 31, 1902.

Freeman C. Coffin, F. F. Forbes, Dexter Brackett, Committee on Standard Specifications for Cast-Iron Pipe, of the New England Water Works Association:

Gentlemen, — The Committee appointed by the Cast-Iron Pipe Founders desire to acknowledge the care and thoroughness with which the subject of standard specifications has been taken in hand by yourselves. In considering the papers submitted, they have viewed them, first, from the standpoint of securing good castings and such as will commend themselves to the general average of the trade, and doing this with the thought of not increasing unduly the cost of manufacturing the pipe, which cost must be in the end borne by the purchaser. They desire you to appreciate that the changes they suggest have in many instances arisen from their intimate knowledge of the business, both from the standpoint of manufacturers and also from the market requirements. They feel the reasons which have prompted them to the changes which have been made had best be discussed by a joint meeting of your Committee and the committee of the Cast-Iron Pipe Founders.

It may be well to give the reasons for departing from the suggestion of a uniform external diameter of pipe. Roughly, they are that adhering to uniform external diameters will tend to increase the cost of manufacturing, and also produce bad pipe. As to the schedule of and variation of weights, the changes in the variation of weight have been made so as to permit of cheapening production, without increasing the cost of the pipe to the buyer. It is to fully explain these and other changes that the pipe manufacturers would be glad to have a meeting with your committee.

SPECIFICATIONS

Suggested by the Foundry Committee.

DESCRIPTION OF PIPES.

The pipes shall be made with hub and spigot joints, which shall accurately conform to the dimensions given in Table No. 1. The nominal diameter shall be the actual diameter.

They shall be true circles in sections, with their inner and outer surfaces concentric.

The straight pipes shall be straight, and the curved pipes shall be true to the required curvature in the direction of their axis.

They shall be of the specified dimensions in internal diameter from end to end, and the straight pipe shall be at least twelve feet in length, exclusive of socket.

Especial care shall be taken to have the sockets of the required size. The sockets and spigots will be tested by circular gages, and no pipe will be received which is defective in joint room from any cause. The joint room for each class of pipe shall not vary more than .06 of an inch from the dimensions given in Table No. 1.

Pipes 16 inches or less in diameter shall be accepted when the thickness of metal in the body of the pipe is not more than .08 of an inch less at any point than the standard thickness, but for pipes over 16 inches in diameter, the variation may be .12 of an inch.

The length of the pipe shall not be changed except by written permission of the engineer, and in case of such change the standard weight of the pipe shall be modified in accordance therewith.

DEFECTIVE SPIGOTS.

Defective spigot ends on pipes may be cut off in a lathe, and a half-round wrought-iron band shrunk into a groove cut in the end of the pipe. No pipe shall be banded which is less than eleven feet in length, exclusive of the socket. That portion of the spigot end of a pipe or special casting which enters the bell shall not be picked or hammered by the inspector.

SPECIAL CASTINGS.

All special castings shall be made in accordance with the cuts and the dimensions given in the tables forming a part of these specifications.

The flanges on all manhole castings and manhole covers shall be faced true and smooth, and drilled to receive bolts of the sizes given in the tables. The contractor shall furnish and deliver all bolts for bolting on the manhole covers, the bolts to be of the sizes shown on the plans, with hexagonal heads and nuts, and sound, well-fitting threads.

MARKING.

Every pipe and special casting shall have distinctly cast upon it the initials of the maker's name, the year in which it was cast, and the class letter. When cast especially to order, each pipe and special casting shall also have cast upon it the number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below, thus, —

1901	1901	1901
1	2	3

etc., also any initials, not exceeding four, which may be required by the purchaser.

The letters and figures are to be cast on the outside, not less than two inches in length and one-eighth of an inch in relief, on pipe eight inches and over; on smaller pipe size of letters to be proportionate.

PERCENTAGE TO BE PAID FOR.

No pipe shall be accepted the weight of which shall be less than the standard weight by more than five per cent. for pipes sixteen inches or less in diameter, and four per cent. for pipes more than sixteen inches in diameter; and no excess above the standard weight of more than the given percentage for the several sizes shall be paid for. The total weight to be paid for shall not exceed for each size and class of pipe the sum of the standard weights for the same number of pieces of the given size and class by more than two per cent.

No special casting shall be accepted the weight of which is more than twelve per cent. less than the standard weight, and not more than twelve per cent. in excess of the standard weight shall be paid for.

QUALITY OF IRON.

The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace. It shall be of such character as to make a pipe strong, tough, and of

even grain, and soft enough to satisfactorily admit of drilling and cutting.

Specimen bars of the metal used, each being 26 inches long by 2 inches wide and 1 inch thick, shall be made without charge as often as the engineer may direct. The bars, when placed flatwise upon supports 24 inches apart and loaded in the center, shall support a load of 1 800 pounds, and show a deflection of not less than .30 of an inch before breaking. Should the dimensions of the bars differ from those above given, a proper allowance therefor shall be made in the results of the tests. The founder shall have the right to pour three bars from each ladle, and the decision of the test shall be based on the average result.

HOW CAST.

The straight pipes shall be cast in dry sand molds, in a vertical position, and the pipe shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

QUALITY OF CASTINGS.

The pipes and castings shall be smooth, free from scales, lumps, blisters, sand holes, and defects of every nature which unfit them for the use for which they are intended. No plugging or filling will be allowed.

CLEANING AND INSPECTION.

All pipes and special castings shall be thoroughly cleaned and subjected to a careful hammer inspection, but no pick shall be used. No casting shall be coated unless entirely clean and free from rust, and approved in these respects by the engineer immediately before being dipped.

COATING.

Every pipe and special casting shall be coated inside and out with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle, nor with any tendency to scale off.

Each casting shall be heated to a temperature of 300 degrees Fahrenheit immediately before it is dipped, and shall possess not

less than this temperature at the time it is put in the vat. The ovens in which the pipes are heated shall be so arranged that all portions of the pipe shall be heated to an even temperature. Each casting shall remain in the bath at least five minutes.

The varnish shall be heated to a temperature of 300 degrees Fahrenheit (or less if the engineer shall so order) and shall be maintained at this temperature during the time the casting is immersed.

Fresh pitch and oil shall be added when necessary to keep the mixture at the proper consistency, and the vat shall be emptied of its contents and refilled with fresh pitch when deemed necessary by the engineer. After being coated, the pipes shall be carefully drained of the surplus varnish. Any pipe or special casting that is to be recoated shall first be thoroughly scraped and cleaned.

HYDROSTATIC TEST.

When the coating has become hard, the straight pipes shall be subjected to a proof by hydrostatic pressure, and, if required by the engineer, they shall also be subjected to a hammer test under this pressure.

The pressure to which the different sizes and classes of pipes shall be subjected is, for

Class	A,	200	pounds	per	square	inch.
,,	B,	250	,,	,,	,,	,,
,,	C,	300	,,	,,	,,	,,
,,	D,	300	,,	,,	,,	,,

WEIGHING.

The pipes and special castings shall be weighed for payment under the supervision of the engineer, after the application of the coal-tar pitch varnish, and the weight of each pipe and special casting shall be conspicuously painted in white on the inside, after the coating has become hard. If desired by the engineer, the pipes and special castings shall be weighed after their delivery, and the weights so ascertained shall be used in the final settlement, provided such weighing is done by legalized weighmaster.

CONTRACTOR TO FURNISH MEN AND MATERIALS.

The contractor shall provide all tools, materials, and men necessary for the proper testing, inspection, and weighing at the foundry of the

pipes and special castings; should the buyer have no inspector at the works the founders shall, if notified by the engineer, furnish a sworn statement that all of the tests have been made as specified, this statement to contain the results of the transverse tests upon the test bars.

POWER OF THE ENGINEER TO INSPECT.

The engineer shall be at liberty at all times to inspect the material at the foundry, and the moulding, casting, and coating of the pipes and special castings. The forms, sizes, uniformity, and conditions of all pipes and other castings herein referred to shall be subject to his inspection and approval, and he may reject, without proving, any pipe or other casting which is not in conformity with the specifications or drawings furnished.

CASTINGS TO BE DELIVERED SOUND AND PERFECT.

All the pipes and other castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the contractor of any of his obligations in this respect, and any defective pipe or other casting which may have passed the engineer at the works or elsewhere shall be at all times liable to rejection when discovered, until the final completion and adjustment of the contract. Care shall be taken in handling the pipes not to injure the coating, and no pipes or other material of any kind shall be placed in the pipes during the transportation or at any time after they receive the coating.

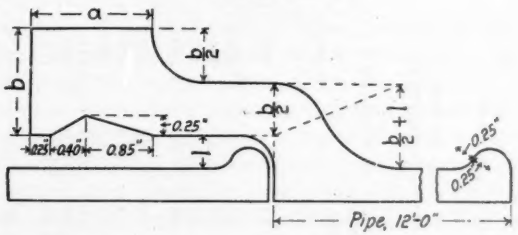
DEFINITION OF THE WORD "ENGINEER."

Wherever the word "engineer" is used herein it shall be understood to refer to the engineer, or inspector, acting for the purchaser, and to his properly authorized agents, limited by the particular duties intrusted to them, and all such instructions by any agents must be stated in writing in order to be binding.

INSPECTORS.

All inspectors must be experienced and fully competent for the work to which they are assigned.

TABLE NO. 1.—GENERAL DIMENSIONS OF PIPES AND SPECIAL CASTINGS.



Diam. Inches.	Depth of Sockets.		Thickness of Joint for Caulking. Inches.	"a."	"b."
	Pipe. Inches.	Special Castings. Inches.			
4	3.00	4.00	.40	1.50	1.30
6	"	"	"	"	1.40
8	3.50	"	"	"	1.50
10	"	4.50	"	"	"
12	"	"	"	"	1.60
14	"	"	"	"	1.70
16	4.00	5.00	.50	1.75	1.80
18	"	"	"	"	1.90
20	"	"	"	"	2.00
24	"	"	"	2.00	2.10
30	4.50	"	"	"	2.30
36	"	"	"	"	2.50
42	5.00	"	"	"	2.80
48	"	"	"	"	3.00

TABLE NO. 2. — STANDARD WEIGHTS AND PRESSURES.

BELL AND SPIGOT CAST-IRON PIPE.

Inside Diameter of Pipe in Inches.	Approximate Laying Length in Feet.	CLASS A. HEAD, 100 FEET. PRESSURE, 43 POUNDS.			CLASS B. HEAD, 200 FEET. PRESSURE, 86 POUNDS.			CLASS C. HEAD, 300 FEET. PRESSURE, 130 POUNDS.			CLASS D. HEAD, 400 FEET. PRESSURE, 173 POUNDS.		
		Thickness.	Weight per		Thickness.	Weight per		Thickness.	Weight per		Thickness.	Weight per	
			Foot.	Length.		Foot.	Length.		Foot.	Length.		Foot.	Length.
4	12	.38	18.3	220	.42	20.3	243	.45	21.7	260	.47	22.9	275
6	12	.41	28.3	340	.47	32.8	393	.51	35.5	426	.54	37.1	445
8	12	.47	42.8	513	.51	47.3	567	.56	52.0	624	.61	55.4	665
10	12	.50	57.1	685	.56	63.8	765	.62	71.0	852	.68	76.7	920
12	12	.53	72.5	870	.60	82.1	985	.68	92.5	1 110	.75	100.8	1 210
14	12	.56	89.5	1 074	.65	102.4	1 229	.73	116.6	1 399	.82	128.3	1 540
16	12	.60	107.8	1 293	.69	124.7	1 496	.79	143.6	1 723	.89	158.3	1 900
18	12	.63	127.7	1 532	.74	149.0	1 788	.85	172.1	2 065	.96	191.7	2 300
20	12	.66	149.0	1 788	.78	175.3	2 104	.91	203.7	2 444	1.03	228.3	2 740
24	12	.75	200.6	2 407	.87	233.6	2 803	1.02	274.9	3 299	1.16	306.7	3 680
30	12	.87	290.2	3 482	1.01	335.6	4 027	1.19	398.6	4 783	1.37	451.7	5 420
36	12	.98	391.6	4 699	1.14	455.0	5 460	1.36	545.3	6 543	1.58	624.2	7 490
42	12	1.10	512.3	6 147	1.28	591.7	7 100	1.54	713.6	8 563	1.79	824.2	9 800
48	12	1.25	665.2	7 982	1.41	745.5	8 946	1.71	904.8	10 857	1.99	1 045.8	12 550

DISCUSSION.

MR. COFFIN. The specifications are printed here, and perhaps you will not see a very striking difference between them and the specifications which were submitted with the preliminary report. I do not know whether you will consider it desirable to have them read or not, as they are appended here, and also the specifications suggested by the foundry committee.

THE PRESIDENT. Can you in a few words state what the changes are, without reading them through?

MR. COFFIN. I can state some of them, I think. I have already referred to abandoning of uniform outside diameters. The Committee, I may say, did their best to retain the original form; they went into the matter very carefully and became convinced it was not a practicable thing to do so. If it had been done, either the cost of the pipe would have been very greatly increased, or there would have been a possibility or a probability of getting a good many poor pipe. It required quite a difference in the thickness of the clay of the core to make all the difference between the thickest pipe and the thinnest pipe, and the manufacturers were unanimously of the opinion — and, after going into the matter thoroughly with them, we became convinced that they were sincere — that it could not be done to the extent that we called for in the original specifications. I believe that we have retained practically all of the benefits that would have been secured by our original proposition, because in the way they are designed it is possible to use the pipe from 4 to 16 inches interchangeably; that is, the lighter weights can be used with the heavier weights in a line, and *vice versa*, and one pattern of special castings can be used for all; and the Committee feel that they have done the best that they could do, everything considered.

There were several valuable suggestions made in the discussion of the preliminary report, and the Committee have adopted a number of them. I am afraid it is going to be rather hard for me to pick these out, but I will try to do so. In compliance with the request of the manufacturers' committee, referring to Section 2 of the Specifications, the allowable variation in the diameter of pipes and sockets was increased. Whereas in the original specifications, if my memory is right, the variation was .06 of an inch for all pipes, it now reads that the diameters "shall not vary . . . more than .06 of an inch for pipes 16 inches or less in diameter; .08 of an inch for 18-inch, 20-inch, and 24-inch pipes; .10 of an inch for 30-inch,

36-inch, and 42-inch pipes, and .12 of an inch for 48-inch, 54-inch, and 60-inch pipes." That varies more in accordance with the size of the pipe than the original specifications did.

The variation in thickness was increased somewhat. I don't remember what it was originally, but it now reads that "for pipes whose standard thickness is less than one inch, the thickness of metal in the body of the pipe shall not be more than .08 of an inch less than the standard thickness, and for pipes whose standard thickness is one inch or more the variation shall not exceed .10 of an inch, except that for spaces not exceeding 8 inches in length in any direction, variations from the standard thickness of .02 of an inch in excess of the allowances above given shall be permitted." That means that if there are thin spots on the pipe covering spaces which do not exceed 8 inches in either direction, the variation in thickness may be greater than it would be for long distances. Of course we all admit that when a pipe is tapped right through for services it does not materially weaken the pipe, at least we are quite ready to do it, and it seemed to the Committee it was quite safe to admit a little more variation on small spaces than on long lengths of pipe.

In regard to defective spigots which may be cut, the original specifications provided for cutting and banding a pipe 20 inches and under to an amount equal to 6 per cent. of the total number of pipes ordered. These specifications allow spigots to be cut on pipes 12 inches and over, the size has been reduced from 20 to 12 on not more than 12 per cent. of the total number; that is, we have doubled the total number which will be accepted.

In these variations from the original specifications to meet the request of the foundries, in some cases we met altogether what they required and in some cases we met them part way; but the members of the Committee considered the matter carefully and used their own judgment, and are now ready to recommend these specifications as they stand.

There has been a change made in regard to special castings. We allowed a little more variation in the diameters of the sockets of the special castings than we did in the pipes, recognizing the fact that special castings are made in a different way, and it is impossible to make them as close to the dimension in diameter as it is the pipe, some of them being made with cores and generally made with split patterns, etc. This is a matter of foundry detail which it seemed to the Committee did not go beyond the limits of good practice.

The change in marking is something which the Committee made of its own motion. Whereas in the original specifications the class letter was to be cast on the pipe, in these it is provided that the mark shall be painted on the inside, the same as the weight. The reason for doing this was that in casting pipe it is difficult to get the first pipe cast of the exact weight, and perhaps several have to be cast before the correct weight of the class can be found. If those overrun a class or underrun it, they can be marked into another class, and the Committee could see no objection to painting the class on the inside of the pipe as well as the weight. We have also allowed the sizes of the letters on pipes less than 8 inches in diameter to be 1 inch in length, whereas before it was provided that they should be 2 inches in length. That is a practical consideration; it is out of the question, perhaps, to cast a 2-inch letter on a pipe smaller than 8 inches.

"Percentage to be paid for," — there is a slight change in that. Whereas the former specification read: "No pipe shall be accepted the weight of which shall be less than the standard weight by more than 4 per cent. for pipes 16 inches or less in diameter, 3½ per cent. for 18-inch, 20-inch, and 24-inch pipes, and 3 per cent. for pipes more than 24 inches in diameter," — that is, the percentages were 4, 3½, and 3, — it now reads that this percentage of variation either above or below the standard weight shall be not "more than 5 per cent. for pipe 16 inches or less in diameter, and 4 per cent. for pipes more than 16 inches in diameter." The requirement as to the total weight for the whole order was not changed — that still remains at two per cent.; that is, the purchaser will not pay for more than two per cent. in excess. The variation in weights of special castings was raised from 6 to 10 per cent. The object of the Committee in meeting the manufacturers' committee on these points was to avoid extra expense where it seemed it would not produce a corresponding benefit.

"Tests of Material." The Committee reduced the requirement slightly for the transverse test. It reads now: "The bars, when placed flatwise upon supports 24 inches apart and loaded in the center, shall for pipes 12 inches or less in diameter support a load of 1 900 pounds and show a deflection of not less than .30 of an inch before breaking, and for pipes of sizes larger than 12 inches shall support a load of 2 000 pounds and show a deflection of not less than .32 of an inch." I believe the original specifications provided for a load of

2 000 pounds for all pipes, with a deflection of .35 of an inch. This was changed somewhat in deference to the conditions at foundries, which are perhaps a little outside of the foundries which would supply pipe for this market; that is, the Western and Southern foundries find it difficult, we are informed, to get iron which will make the proper mixture to reach the requirement we had originally made.

There is a little change in the casting of pipes. It reads now: "The straight pipes shall be cast in dry sand molds in a vertical position. Pipes 16 inches or less in diameter shall be cast with the hub end up or down, as specified in the proposal." Before it was to be as required by the engineer.

"Quality of Castings." The present specifications read: "The pipes and special castings shall be smooth, free from scales, lumps, blisters, sand holes, and defects of every nature which, in the opinion of the engineer, unfit them for the use for which they are intended." That last clause was inserted at the request of the foundries, — or, rather, their request was that it should read, "and defects of every nature which unfit them for the use for which they are intended," and the Committee inserted the words, "in the opinion of the engineer."

I believe those are about all the sections which were changed in deference to the manufacturers' committee. There was one section put in as follows: "The inspector at the foundry shall report daily to the foundry office all pipes and special castings rejected, with the causes for rejection." That seemed to be a reasonable requirement.

It is a little more difficult for me to remember the things which were put in on account of the discussion by members of the Association, for they are not so fresh in my mind. Here is one thing which was suggested in regard to the test of material: "In default of definite instructions the contractor shall make and test at least one bar from each heat or run of metal." And at the request of the manufacturers this clause was put in: "The contractor shall have the right to make and break three bars from each heat or run of metal, and the test shall be based upon the average results of the three bars."

There were some changes made in the hydrostatic test, but I really can't describe them now. And this clause was put in: "Bids shall be submitted and a final settlement made upon the basis of a ton of 2 000 pounds."

The Committee have also changed the form of the spigot ends and made a slight change in the form of the sockets, somewhat in accord-

ance with what was suggested in the discussion. By referring to the cut you will see that the bead on the spigot end is made somewhat heavier, and the socket meets the body of the pipe by a small fillet or extra thickness in the metal, shown on the cut by a dotted line. This is simply a practical detail of foundry work, as most pipe are cast that way, and the Committee thought it better to make the cut correspond with the practice. It was suggested that there should be a taper shown on the line of the socket marked "a." The Committee considered that it was the practice in all casting for the pattern-makers to make what is called a draft on the pattern, to allow the pattern to draw out of the sand, and that it was not necessary to show that on the cut. I presume that there are things which I have forgotten to state, but I have mentioned all which occur to me now.

THE PRESIDENT. I consider this report one of the most important ever submitted to this Association, and I hope there will be a full and free discussion. The report is now before you, gentlemen, for your consideration.

MR. COFFIN. One more thing I would like to speak of, Mr. President, and that is, that the table of weights of pipe, Table No. 2, was changed by omitting every other class of the sizes from 4 to 8 inches, and carrying the classes a little further on in the case of those sizes, and also in the case of pipe up to 16 inches in diameter. The original table provided up to Class F, but now 4-inch pipe go to Class K, 6- and 8-inch to Class I, and 10-, 12-, 14-, and 16-inch to Class H. This was to provide for practice where they use heavier pipe than is customary in this vicinity.

THE PRESIDENT. We shall be glad to hear from any one who is interested in this matter of standard specifications for cast-iron pipe.

MR. LEONARD METCALF.* It seems to me that the Committee has presented such an excellent set of specifications that there is not much to criticise, and without opportunity for criticism it is very hard to get up a discussion. I agree very heartily with our President that the Committee have done a work of great value to our Association and to water-works men in general. I only hope that their work may extend a little further, and that they will give us also, as I believe they intend to do, a list of special castings which can be used in conjunction with these specifications.

MR. COFFIN. It is the intention of the Committee to prepare

* Civil Engineer, Boston, Mass.

such a list if the specifications are adopted. It will involve considerable labor and some expense, therefore the Committee concluded it was better not to undertake to do it until the matter of the specifications was finally settled.

MR. METCALF. I should like to ask Mr. Coffin if it is the idea of the Committee that it would be wiser to adopt these specifications now, or whether they think the matter had better be held open to await action on the part of any of the other associations, as, for instance, the American Water Works Association. I believe that organization is considering this matter, and I do not know but what the Committee has been in correspondence with its committee, although no allusion is made to that in the report.

MR. COFFIN. I do not know that I can answer that question for the Committee. We feel that we have done our work now, and we have presented these specifications to the Association for it to adopt or to take any action which it sees fit in regard to them. As I look at it, I think nothing would be gained by delay. I believe that if there were any important changes to be made in order to come to an agreement with other associations, perhaps they could be made afterwards as well; and I think it may be fair to say that no action will be taken by other associations until this Association takes action on these specifications. I would like, however, to hear from the other members of the Committee on this point, for I do not assume to speak for them upon this matter, as that is something which has not been discussed in the Committee.

MR. METCALF. In other words, you think that if this Association takes the initiative in this matter the other associations will fall into line.

MR. COFFIN. Yes, sir; and perhaps suggest some desirable amendments.

MR. CHARLES W. SHERMAN. On that subject, Mr. President, it may be of interest for me to say that I was looking over the report of the last convention of the American Water Works Association no longer ago than last evening, and read there the action taken by their committee on cast-iron pipe specifications. The report of that committee consists principally of a statement that our Committee is doing valuable work in this direction and a reprint of the preliminary specifications prepared by our Committee last winter, with the suggestion that those specifications, or revised specifications, would come up for final adoption at our convention in September, and a

request that any of their members who had anything further to add on the subject would forward it either to their own secretary or to ours before the date of this meeting. We having heard nothing from them up to this time I assume that we will not, and I should be inclined to think that their committee stood ready to indorse our Committee's action, and that their association will indorse what their committee recommends.

THE PRESIDENT. Your impression would be that they are waiting for the action of this convention?

MR. SHERMAN. Precisely.

MR. BRACKETT. I received, some time ago, a letter from the chairman of the committee on pipe specifications of the American Water Works Association, in which he stated that he should recommend for adoption the form of specification which was adopted by this Association.

It may be of interest to the members to hear the names of the pipe founders who have been consulted during the preparation of our report, as showing how wide a field was represented and the foundries which will be likely to accept these specifications if we adopt them. The manufacturers represented at our conferences were the United States Cast Iron Pipe and Foundry Company, which now owns and controls the cast-iron pipe plants at Burlington, N. J.; Buffalo, N. Y.; Scottdale, Pa.; Cleveland, Columbus, and Addyston, Ohio; Newport and Louisville, Ky.; Chattanooga, Bridgeport, and South Pittsburgh, Tenn.; Bessemer and Anniston, Ala., and West Superior, Wis. Messrs. R. D. Wood & Co. represented their plants at Camden and Florence, N. J.; and there were also represented the Donaldson Iron Company, Emaus, Pa.; the Warren Foundry and Machine Company's plant at Phillipsburg, N. J., and the plants at Lynchburg and Radford, Va. In all there were twenty foundries, represented by a committee which very carefully considered the specifications and consulted with us. I wish to say that the changes which have been made in the specifications since the preliminary draft was presented have been very largely the result of investigations which were made by the committee. Some of the changes, as you know, were suggested by members of the Association; some have resulted from our conferences with the manufacturers; some have been suggested to us by further study, and also by consultation with the pipe inspectors, who have, for many years, been acquainted with the best practice in the foundries, and who have given us their opinion as to the requirements necessary in order to obtain good castings.

MR. MORRIS KNOWLES.* I am thoroughly in favor of standardization, whether it be of specifications or of statistics and accounts, but an incident that came under my observation some months ago has led me to wonder whether it will be entirely an advantage to have so many different classes of pipe. I will first tell the incident, and then I will ask a question. Something over 1 000 tons of pipe was wanted about, I think, Class C mentioned in these specifications. That does not happen to correspond with some of the standards of the Western foundries, which are heavier. After the bids were received, it was found that they were considerably in excess of the estimated cost of the work based upon standard prices current at that time for cast-iron pipe. Inquiry disclosed the fact that a certain percentage was added to the weights of pipe as they were designed, and a little increased price was charged besides that; in other words, the percentage added was not enough to bring it up to the standard of the pipe foundries in that part of the country, and therefore a little further percentage was added which, in fact, made the cost slightly more than it would have been if the standard of the various foundries had been taken. Of course, engineers desire, in specifying light weights, to save material, but if that cannot be done perhaps it is not an advantage to have so many classes. It looks, on the face of it, the manufacturers having suggested only four classes and the Committee having suggested five or more, as though possibly there might be something in their suggestion. I would, therefore, like to ask the Committee whether that matter came up in their discussions, and whether they think there is a reasonable surety that if light weights are used for certain works it will be an advantage in point of cheapness.

MR. COFFIN. I do not know that I can answer that question directly. Of course it is well known that the lighter the class the higher the price. In my own practice I have found that I could get the lighter weight cheaper, that is, for a smaller total cost, than I could get the heavier weight. But the Committee, as has been stated a number of times, felt that perhaps it was not their business, or the province of these specifications if adopted by the Association, to dictate to any engineer or any user of pipes what weights he should use; and besides that we wished the specifications to have as broad an application as possible. Now, I do know that there are engineers who are using pipe as light as anything we have provided for here,

*Civil Engineer, Pittsburg, Pa.

and perhaps in some cases lighter; and while, perhaps, no member of the Committee would use the lightest weight, still it seemed just as desirable to provide for the use of those light weights as it did on the other hand to provide for the use of the heavy weights, and then let each engineer or user select whichever he saw fit, and if his lighter weights cost him more than his heavier weights, that is his business. We recognized, however, the desirability of having as much simplicity as possible. The whole matter has been quite thoroughly considered, and while the Committee would not presume to say that they have made absolutely the best arrangement, still, in our opinion, we have done as well as possible under the circumstances.

Mr. Knowles. Did the manufacturers' committee express any strong reasons why they recommended only four classes?

Mr. Coffin. I don't remember anything in particular. Possibly Mr. Brackett or Mr. Forbes may be able to answer that question.

Mr. Brackett. I think it was simply this, that the manufacturer would prefer to make two classes or only one class. But as the members of the Association have expressed their desire to purchase several classes or weights of pipe, the Committee felt that it ought to endeavor to provide for their desires, and we have tried to make as few classes as will meet all reasonable demands. I understand that the Western practice is not to make smaller sizes of pipe as light as are often used in New England.

Mr. E. H. Gowing.* I think Mr. Brackett has stated that about as it is, — that the pipe foundries would like to make as few classes as they possibly can. I think the specifications are good ones, they certainly have been prepared by as good men as there are in the water-works business, and I shall be very much disappointed if the Association does not adopt them. If it is proper to make such a motion at this time, I will move that the report of the Committee be accepted and that these specifications be adopted as the standard of the New England Water Works Association.

Mr. G. H. Benzenberg.† I am glad to see that the New England Water Works Association has given attention to that portion of water-works construction which heretofore has been pretty generally neglected. For the past twenty-five or thirty years particular attention has been given to those parts which are constantly visible, not only to the eye of the superintendent and operator, but also to the

* Civil Engineer, Boston, Mass. † Civil Engineer, Milwaukee, Wis.

eye of the community. The engineer and the superintendent have raised the requirements of their specifications from time to time, and the manufacturer has been willing to meet them, with the result that to-day we have pumping machinery which will develop a duty two or three times that which twenty-five or thirty years ago was supposed to be a fair average duty for pumping machinery. The distribution system of a water-works plant generally represents the largest item of cost. There is a greater sum of money invested in that branch of the works than in perhaps all the other branches taken together, and yet it has received the least attention. I dare say that only a comparatively small number of water-works managers have thought it necessary to have that branch of their work properly inspected, in order to secure compliance with the specifications, most of them accepting the pipe without inspection at the foundry. The result has been that gradually the pipe foundries have got into the habit of furnishing pipe from stock, which is undoubtedly for them the most convenient and economical arrangement.

The greater attention which has been given to boilers, pumping engines, etc., and which has resulted in supplying a much better class of machinery, was, and is undoubtedly, due to the increased economy which was obtained. It may be because the pipe distribution system is out of sight, and therefore largely out of mind, that less continuous attention has been given to its condition and to the economy which might be obtained from a better constructed and protected pipe. Nevertheless, as water-works plants are growing older, and these pipe distribution systems have been in service for a long time, examinations are being made, and it is found that they have very materially deteriorated in efficiency where soft or surface waters have been distributed, especially if the pipe was poorly prepared and indifferently coated. In some cities the standard requirements of specifications for pipe have, in recent years, been increased both as to the character of the iron and as to the method of casting, cleaning, and coating them.

Attention should be given to see, first, that the pipe is thoroughly cleaned, and it seems to me there is no better way of cleaning them than by the sand blast. By it you will remove all dirt or dust that may possibly be left upon the surface of the pipe, and the coating will then come in contact with the clean metal. The benefit of sand blasting has been very noticeable in the excellent results which have

been obtained. In draining the pipe after dipping into the bath, the coating does not peel off as it otherwise might have done at points where particles of dust or dirt had remained upon the pipe, and which points were left to corrode by the action of the water.

The coating also should receive particular attention. It has been the general custom of foundries to buy pitch from which all products of any commercial value have been extracted and which has been cut back with some dead oil, and put it in the tank for coating. The coating material should be as specifically and carefully prepared as any other article in the process of manufacture. Tests have been made to determine to what extent coal tar should be heated so as to evaporate only the lighter oils and restrain those which are beneficial to the residue as a coating for pipe. We cannot do too much in the way of studying and discussing this subject, and when we have arrived at a conclusion that it is best to raise the standard requirements in our specifications, they should then be so raised. It is for the engineer to determine, and for the contractors to furnish. The engineer should determine carefully what is required, and thereupon exact from the contractors a strict compliance with such requirements; and I haven't any doubt that when it comes to them in that form they will meet the requirements of the engineer. They may ask an increased price for it, but will not the money be as well invested as it is in higher grade machinery, and won't as full a return be secured from it? I believe that the day will come when the engineer will see the increased benefit in pipe prepared to an ideal condition, and that he will specify such, that he will specify the pipe to be enameled, coating it, perhaps, with a porcelain enamel. What would be the result? He would have to pay from fifteen to twenty per cent. more for his pipe, certainly not over twenty per cent. more than the present cost of pipe, for such improved conditions. In return he would receive a pipe having from fifteen to twenty per cent. additional conveying capacity, besides which it would be in a condition to resist all corrosive action, even that of the electric current, and which would retain its full carrying capacity, probably, for the life of cast iron so protected, the period of which I don't believe I would want to state. The benefits to be derived from such pipe, it seems to me, would, as a water-works plant increases in age, be far in excess of the additional cost which would be entailed. I don't doubt but what to-day, if properly enameled water pipe were required, some manufacturer would meet the requirement, and if he did, others would have to follow if they wished

to remain in the business. It has been so in the construction of water-works pumping machinery, and I do not see why it should not be so in every other line of manufacture required by the water-works engineer.

For these reasons it seems to me that you have not set the requirements in these specifications any too high for the foundry men to meet. I am satisfied if you will insist upon the terms of your specifications, and that even if you were to make them much more stringent, the contractor will find it to his advantage to meet them, not at the cost at which he is supplying pipe as now furnished to the market, but at an additional cost, although such an additional cost will not be in excess of the advantage gained, and need not be prohibitive. In a contest which was had with some of the largest manufacturers of pipe, where the specifications were quite rigid, the contractors tried hard to have them amended, but the engineers insisted upon the requirements, and after some delay the manufacturers met them. They asked an additional price at first for the improved character of cleaning and coating, but I understand that to-day they are furnishing just such pipe without any additional charge, as they have found it to be just as cheap to clean them properly with the sand blast and to give them a better coating.

I did not expect to take so much of your time, Mr. President, and I did not come here prepared to say anything on this subject, but it is a matter in which we are all deeply interested, and one that is well worth our giving more attention and more study to in the future than it has received at our hands in the past.

THE PRESIDENT. Mr. Benzenberg, to my knowledge, has made a careful study of this subject, and we all appreciate his having come from so great a distance to attend this convention and to address us. Does any other member of the Association wish to say anything upon the question? Mr. Hawley is called for.

MR. W. C. HAWLEY.* I can merely indorse what Mr. Benzenberg has so well said. I believe I mentioned the matter of the sand blast in my remarks on this subject a year ago, and I have backed up my opinion by embodying it in specifications, at any rate, as an alternative. I think that the matter of coating is one which demands attention. It has received some attention, and some improvement has been made in that direction, but I believe that there is room for more. There is one matter which perhaps is

*Superintendent and Engineer, Pennsylvania Water Co., Wilkinsburg, Pa.

a little out of line, and yet it will follow immediately upon the adoption of such a set of specifications as has been presented, to which I would like to refer, and that is the importance of securing the enforcement of them.

In a case that came to my knowledge not long ago, a set of specifications was prepared, calling for certain material and certain results, and specifically stating certain conditions which would result in the rejection of the pipe, and a contract was awarded. A considerable quantity of the pipe was cast, and the inspector, who was a first-class man, a practical foundryman, and a man of perfect integrity, rejected practically all the pipe which he inspected. The engineer looked into the case and found that the inspector was perfectly right in rejecting the pipe under the specifications, and yet the contractor insisted that the pipe must be accepted, basing his insistence upon the claim that they were "commercial castings," as he termed it. That case is not yet settled. The pipe were not accepted, and the municipality was put to a very large expense, and the controversy will finally be threshed out in the courts. The municipality intends, I believe, to have it determined whether or not it has any rights which a contractor is bound to respect.

Now, that is what we find ourselves up against oftentimes when it comes to the enforcement of such specifications as these, and it is a matter which deserves the careful consideration of every superintendent and engineer.

MR. BRACKETT. Mr. President, I do not know as I care to prolong the discussion, but I wish to say that I am very heartily in accord with the statements made by the last two speakers. I think there are many specifications for water pipe that contain provisions which are impracticable and which are therefore not enforced by the inspectors. I have discovered this during my visits to the pipe foundries during the past twenty years and from constant association with inpectors. I think, however, that the requirements of our proposed specifications can be enforced by an inspector, and that good work will be the result of such enforcement. I should be very glad to see a better protective coating and better cleaning of the pipe, and I think the time is coming when we shall have them. There is no reason why any member of this Association should not improve on these specifications, but for general practice it seems to me that the Committee has gone about as far as it is practicable to go at this present time. Some pipes for my own work are now being cleaned

by the sand blast and coated with what may be an improved coating, although time alone will decide. A number of years ago I made quite an extensive series of experiments for the purpose of obtaining a better coating than was then used upon pipes, but was not able to find anything at that time which I thought was practicable to use.

THE PRESIDENT. If there are any representatives of pipe foundries present, we hope they will not be bashful about speaking on this subject.

MR. ROBERT S. WESTON. I should like to ask the Committee if they considered the desirability of incorporating in the specifications anything in regard to the chemical constituents of the iron; that is, that there should not be more or less than a certain amount of carbon and different things of that character, as is customary in specifications for iron for some kinds of structural work.

MR. COFFIN. The Committee did consider that, and also a great many other things to which no reference has yet been made. I was very much interested in the discussion by Mr. Benzenberg, and by some of the other speakers, and it has suggested something to my mind which I wanted to speak of. I will say, to begin with, that I believe it has been the endeavor of the Committee to prepare specifications which would represent a high average practice; that is, if these specifications are followed, the pipe that is furnished will, in my opinion, be very much superior to the pipe that is furnished and used to-day, not, perhaps, by the Metropolitan Water Board, not by large cities and by the ablest engineers, but throughout the cities and towns where pipe is bought and used as it is to-day, necessarily, a great deal of it, without the advice of any engineer. I believe that if these specifications are adopted and enforced, very much superior pipe will be obtained in such cases. If these specifications are adopted by this and other associations, such action will undoubtedly result in their adoption by the foundries.

Now, in relation to higher requirements, I will say that that matter was considered, and it seemed to the Committee that those might be regarded as in the nature of pioneer requirements; for instance, the sand blast, superior methods of coating and chemical requirements, and all those things which can be readily asked for by any engineer, in addition to the requirements of these specifications. These specifications, perhaps, may be considered as a groundwork, a basis, and any refinements which may be desirable — and all this

pioneer work is desirable and necessary — can be introduced in addition, but it did not seem best to include them in a set of standard specifications which it is hoped will cover a wide range of practice.

Then another point which has been raised, is as to the enforcement of these specifications. I should like to say that to make them of any value, it is of the utmost importance, if they are adopted by the Association and favored by the members, for us all to see that when we buy pipe the provisions of the specifications are carried out, so far as we can do so; because if we simply order the pipe, and say that it must conform to the specifications of the New England Water Works Association, and then pay no more attention to the matter, we shall get the same pipe that we are getting to-day without specification. But I believe, as I have said before, that if these specifications are adopted and enforced, we shall get in a majority of cases very much better pipe than we have had in the past.

Mr. Edward V. French. I understand that this question of the number of classes has already been discussed to a considerable extent by members of the Association, but Mr. Knowles has brought the matter up again and I should like to ask whether, if members of the Association would like to have these specifications become the standard, it would not perhaps help them to win their way with the practical foundrymen if there were fewer classes. It seems to me as if the difference is so small that if we could get down to a few classes the foundrymen would make those regularly, and then if an engineer should desire to shade those classes on his own best judgment he could do so. Perhaps I may not understand the matter aright, but my point is this, that when we have so many classes the different superintendents and users of pipe may order first one class and then another, perhaps without any very great reason for their selection and distinction between the very small differences, with the result that the foundrymen will be a good deal bothered by these small shades of difference; and I wondered whether in the long run we could not get right down to three or four sizes which would represent good average practical conditions for the large majority of work, and then let the engineer, who is the man ordinarily to decide on these small differences, order any special size he wants, the specifications which the Association puts out representing something a little bit simpler.

Mr. Gowing. Mr. President, I think the Committee has got this down simple enough, and that really instead of shading these specifi-

cations at all they should be made more strict rather than less strict. As some of the previous speakers have said, let us make the specifications as we think they ought to be, and the foundrymen will live up to them. Just as they have done as to other kinds of machinery, they will do as to cast-iron pipe. Let us make the specifications such as they ought to be, specify what we want to get, and see that we get it, and in a short time the foundrymen will be making pipe just exactly as we want it, and by and by we can add the sand blast and all these other things.

Mr. French. Mr. President, if I may say just one word more, I think the gentleman does not quite get my point. I have no doubt that we can get just what we want if we know what that is; but the question is whether from a commercial standpoint there is any real gain in splitting the thing up so fine that the foundrymen have to carry all these different sizes, and whether we are not really making it cost us more than it would if we would let them come right down to three or four sizes and put all their energies right on to those. It is not a question of making our specifications better or more strict; that has nothing to do with it. It is just a question of commercial expediency. Now, I have no interest in the foundries, but as a general proposition I think it is true that in any kind of specifications for standard work the fewer the number of requirements the better. Of course if the commercial demands require so many sizes, all right, — that is something I don't know about, — but apparently this matter of the number of classes has not yet been satisfactorily settled in every one's mind, judging by what has been said here, and therefore I have ventured to bring it up again.

Mr. John C. Whitney.* As a matter of fact, Mr. President, it seems to me that these proposed specifications really simplify things for the foundrymen. As it has been in the past each water works of any size has had its own particular form of specifications, and the foundry people have been asked to bid on these special patterns which have been provided. Now, it seems to me that with these specifications the thing will be brought down to possibly five or six classes, and I should think that the foundrymen would really want a standard such as this is.

Mr. Brackett. The gentleman suggested having three or four classes. For sizes as high as ten inches there are only five classes, — there is one additional class on the 4-inch, but I think it would be

* Water Commissioner, Newton, Mass.

very seldom used, — and on classes above 10-inch the foundries seldom carry pipe in stock, so that the pipes would be made on orders in any case.

Mr. Benzenberg. These classes, it must be borne in mind, cannot be adhered to for all time to come. Changes in the thickness of pipe will necessarily be made as the quality of material is improved. The higher the grade of metal used, the thinner the shell of the pipe necessary to resist the strain. Undoubtedly during the past few years the quality of the metal has been much improved upon, and as I think it will be recognized that the limit has not yet been reached, these improvements will continue for years to come, and, necessarily, the thickness of the pipe will have to change. There is no necessity of wasting material by putting as much of the improved material into a pipe as was required to meet a certain strain with the old material, when you can do it with perhaps two thirds or three quarters of the former thickness of the shell. It seems to me for that reason that these classes which specify the various thicknesses can be modified before very long anyway, — just as soon as the foundries use a better quality of iron. They are now using a grade of iron with a tensile strength of from 24 000 to 28 000 pounds, whereas, perhaps only a few years back, the tensile strength was 16 000 to 18 000 pounds, and naturally the shell does not need to be so thick now as formerly. That is the distinction, as I understand, in these specifications, and they won't be likely to hold very long anyhow.

Mr. Gowing's motion to accept the report of the Committee and to adopt the specifications as the standard of the New England Water Works Association, was put and unanimously adopted.

Mr. Sherman. It seems to me it is not out of place at this time to suggest a vote of thanks to the Committee which has rendered us such able, and, I might say, distinguished service, and I therefore move that the thanks of the Association be given to Mr. Coffin and to Mr. Brackett and to Mr. Forbes.

Mr. Brackett. Mr. President, as one member of the Committee I wish to say that I feel I have only done my duty as a member of the Association, and I do not think that the Association should pass a vote of thanks to any of its members.

Mr. Coffin. I believe that is the view of the Committee as a whole.

Mr. Sherman. I will then withdraw the motion.

The President. I think I may be permitted to say that the Association appreciates the work that this Committee has done.

PROCEEDINGS OF THE TWENTY-FIRST ANNUAL CONVENTION.

SEPTEMBER 10, 11, 12, 1902.

BOSTON, MASS.,
September 10, 11, 12, 1902.

The twenty-first annual convention of the Association was held at Boston, Mass., on Wednesday, Thursday, and Friday, September 10, 11, and 12, 1902. The headquarters of the Association during the convention were at the Hotel Brunswick, and the meetings were held in the banquet hall of the hotel.

The following members and guests were registered: —

MEMBERS.

Charles F. Allen, Francis E. Appleton, R. C. Bacot, Jr., M. N. Baker, Charles H. Baldwin, Lewis M. Bancroft, F. A. Barbour, Kenneth Allen, C. H. Bartlett, J. E. Beals, E. W. Bemis, G. H. Benzenberg, J. F. Bigelow, F. E. Bisbee, G. H. Bishop, J. W. Blackmer, W. L. Blossom, George Bowers, Dexter Brackett, E. C. Brooks, Fred Brooks, G. A. P. Bucknam, James Burnie, George Cassell, J. T. Cavanagh, G. F. Chace, E. J. Chadbourne, J. C. Chase, H. W. Clark, R. L. Cochran, W. F. Codd, F. C. Coffin, R. C. P. Coggeshall, D. W. Cole, M. F. Collins, B. I. Cook, H. A. Cook, F. H. Crandall, G. K. Crandall, J. W. Crawford, G. E. Crowell, A. W. Cuddeback, G. D. Curtis, J. M. Davis, C. E. Davis, A. O. Doane, L. S. Doten, E. R. Dyer, August Fels, B. R. Felton, C. R. Felton, J. N. Ferguson, G. W. Field, H. A. Fiske, Desmond FitzGerald, J. H. Flynn, F. F. Forbes, W. E. Foss, E. V. French, A. D. Fuller, S. De M. Gage, J. C. Gilbert, D. H. Gilderson, T. C. Gleason, A. S. Glover, W. J. Goldthwait, J. W. Goodell X. H. Goodnough, J. A. Gould, F. W. Gow, E. H. Gowing, J. W. Graham R. A. Hale, J. O. Hall, E. A. W. Hammatt, J. C. Hammond, Jr., L. M. Hastings, V. C. Hastings, L. E. Hawes, W. C. Hawley, Allen Hazen, F. W. Hodgdon, H. G. Holden, J. L. Howard, W. D. Hubbard, W. E. Johnson, E. J. Johnson, E. W. Kent, Willard Kent, Patrick Kieran, F. C. Kimball, Horace Kingman, Morris Knowles, C. F. Knowlton, E. S. Larned, R. S. Lea, A. A. Knudson, W. F. Learned, J. W. Locke, C. S. Lord, H. A. Lord, D. B. McCarthy, F. A. McInnes, H. V. Macksey, A. D. Marble, A. E. Martin, W. E. Maybury, F. E. Merrill, Leonard Metcalf, H. A. Miller, J. T. Miller,

21st Annual Convention N. E. Water Works Assn.,
Boston, Sept. 11, 1902.

C. P. Moat, F. L. Northrop, P. D. O'Connell, C. B. Parker, W. W. Patch, W. Paulison, A. G. Pease, E. L. Peene, J. H. Perkins, T. F. Richardson, W. W. Robertson, P. P. Sharples, E. M. Shedd, C. W. Sherman, G. T. Staples, M. R. Sherrerd, M. A. Sinclair, H. E. Smith, J. Waldo Smith, G. H. Snell, H. T. Sparks, J. F. Sprenkel, G. A. Stacy, F. P. Stearns, N. W. Stearns, G. F. Swain, J. G. Tenney, R. J. Thomas, H. L. Thomas, W. H. Thomas, J. L. Tighe, S. Everett Tinkham, D. N. Tower, C. K. Walker, C. S. Warde, R. S. Weston, William Wheeler, J. C. Whitney, W. P. Whittemore, G. E. Wilde, F. I. Winslow, G. E. Winslow, E. T. Wiswall, L. R. Woods, E. P. Walters, C. J. Youngren. — 157.

HONORARY MEMBER.

F. W. Shepperd. — 1.

ASSOCIATES.

Ashton Valve Co., by C. W. Houghton; Barr Pumping Engine Co., by J. O. Cheever; Harold L. Bond & Co., by Harold L. Bond; Builders Iron Foundry, by F. N. Connet; Chadwick-Boston Lead Co., by A. H. Brodrick and C. N. Fairbairn; Chapman Valve Mfg. Co., by E. G. Howard and Edward F. Hughes; Charles A. Claflin & Co., by Charles A. Claflin; Coffin Valve Co., by H. L. Weston; Wm. V. Briggs; Garlock Packing Co., by Horace A. Hart; Hersey Mfg. Co., by Albert S. Glover, J. A. Tilden, and F. C. Hersey, Jr.; International Steam Pump Co., by A. M. Pierce; Henry F. Jenks; Kennedy Valve Co., by M. J. Brosnan; Lamb & Ritchie, by Henry F. Peck; Lead Lined Iron Pipe Co., by Thomas E. Dwyer; Ludlow Valve Mfg. Co., by H. F. Gould; Charles A. Moore, by F. T. Tapley; H. Mueller Mfg. Co., by Adolph Mueller; John M. Holmes; Jenkins Bros., by H. F. Fiske, H. C. White, and J. D. Stiles; Library Bureau, by W. H. Britigan; National Meter Co., by Charles H. Baldwin, W. P. Oliver, and J. G. Lufkin; Neptune Meter Co., by H. H. Kinsey and D. B. McCarthy; Norwood Engineering Co., by H. W. Hosford; Perrin, Seamans & Co., by Charles E. Godfrey and James C. Campbell; Pittsburg Meter Co., by T. C. Clifford; Rensselaer Mfg. Co., by Fred S. Bates; Edward Robinson; Ross Valve Co., by William Ross; A. P. Smith Mfg. Co., by A. P. Smith and W. H. Van Winkle; Sumner & Goodwin Co., by F. D. Sumner; Sweet & Doyle, by H. L. DeWolfe; Thomson Meter Co., by Henry C. Folger and S. D. Higley; Union Meter Co., by C. L. Brown, F. L. Northrop, and A. S. Otis; U. S. Cast Iron Pipe and Foundry Co., by Edward T. Stuart; Walworth Mfg. Co., by George E. Pickering; R. D. Wood & Co., by Charles R. Wood; A. W. Chesterton & Co., by W. H. Greenwood; Stilwell-Bierce & Smith-Vaile Co., by F. H. Hayes. — 54.

GUESTS.

Michael Walsh (Water Commissioner), Yonkers, N. Y.; Mrs. W. H. Van Winkle, East Orange, N. J.; Mrs. T. C. Clifford, East Pittsburg, Pa.; S. B. Read, *Engineering News*, Boston, Mass.; Mrs. Helen M. Hawley and Mrs. Mary Stewart Miller, Wilkinsburg, Pa.; Mrs. Washington Paulison, Passaic,

N. J.; James P. Bacon, Cambridge, Mass.; George H. Partridge, *Engineering Record*, Boston, Mass.; Mrs. Adolph Mueller and Master William Everett Mueller, Decatur, Ill.; Mrs. Willard Kent, Narragansett Pier, R. I.; Edgar W. McCormack, Cuba; Fred C. Gifford and Hon. Murray D. Clement, Waltham, Mass.; Henry Eaton, Waltham, Mass.; John C. DeMello, New Bedford, Mass.; W. F. Whitman, Dedham, Mass.; Mrs. E. C. Brooks, Cambridge, Mass.; Herbert E. Whuttle, Knoxville, Tenn.; R. R. Swisher, Addison, Ohio; Mrs. F. N. Connet, Providence, R. I.; Mrs. W. H. Thomas, Hingham, Mass.; G. S. Walker, Dorchester, Mass.; C. T. Hawley and Miss Fannie L. Billings, Cambridge, N. Y.; E. L. Arundel, Frank L. Weaver, H. C. Taft (Members Water Board), Lowell, Mass.; R. A. Thayer, Woonsocket, R. I.; E. C. Gerrish, Tewksbury, Mass.; Mrs. George Bowers and Miss Ellen M. Weaver, Lowell, Mass.; Mrs. Lenor H. Knowlton, Miss A. M. Nightingale, Miss M. L. Gavin, Quincy, Mass.; Mrs. C. E. Davis, Upper Montclair, N. J.; Mrs. A. A. Knudson, New York City; Miss Helen F. Esmond and Mrs. D. B. McCarthy, Waterford, N. Y.; John Anderson, Binghamton, N. Y.; A. F. Hall, Marlboro, Mass.; Mrs. Charles S. Warde, Staten Island, N. Y.; Mrs. A. G. Pease, Spencer, Mass.; Mrs. C. W. Houghton, Boston, Mass.; Mrs. F. A. Houghton, Belmont, Mass.; Mr. M. C. Hyde, Springfield, Mass.; Mr. C. H. Allen, Boston, Mass.; Horace Ropes, South Framingham, Mass.; L. S. Cole, Kingston, Mass.; Fred A. Beals, Everett, Mass.; S. M. Spencer, Malden, Mass.; George A. Sanborn, William M. Collins, Lawrence, Mass.; Joseph T. Swan, Everett, Mass.; S. G. Johnson, Newton, Mass.; F. E. Hunter, W. F. Upham, and Miss J. M. Ham, West Newton, Mass.; Charles F. Merrill, Fred M. Hutchinson, Marion Merrill, W. E. Whitney, G. W. Snow, E. A. Binney, J. A. Durell, J. C. Taylor, Charles E. Childs, Fred S. Young, R. J. O'Malley, Thomas McNeill, and Harry Van Idinsture, Somerville, Mass.; H. B. Thoms, Mrs. James C. Campbell, F. A. Morrison, C. B. Moore, Edward W. Howe, Edward M. Hartwell, Mrs. J. D. Stiles, F. E. Lenaue, Boston, Mass.; James A. Bailey, Jr., Member Metropolitan Water and Sewerage Board, Arlington, Mass.; G. A. Winsor, Division Engineer, Metropolitan Water Works, South Framingham, Mass. — 82.

RECAPITULATION.

Members	157
Honorary Member	1
Representatives of Associates	54
Guests	82
	294
Counted twice	3
Total attendance	291

WEDNESDAY, SEPTEMBER 10.

The convention was called to order at 11 A.M., by President Merrill, who said: —

The hour appointed for this meeting has now arrived, and I have to announce the opening of the twenty-first annual convention of the New England Water Works Association.

We expected to have the pleasure this morning of listening to an address by his Honor Mayor Collins, but word has been received from him that it will be impossible for him to be with us, and we shall therefore be deprived of the pleasure which we had anticipated in listening to his remarks. I assure you, however, although I am not empowered to tender to you the customary official greeting of the city in which we are convened, that Boston extends to you a most cordial welcome, that the latchstring of hospitality is out for you in whatever direction you may wander, and that you are in the hands of friends whose endeavor it will be to see that this convention is both pleasant and profitable to you.

We have with us this morning a gentleman whom we have come to regard as a standby, and who has assisted us on numerous other occasions; I take pleasure at this time in calling upon Ex-Mayor John O. Hall, of Quincy, to say a few words to you.

Address of Welcome by Ex-Mayor John O. Hall, of Quincy.

Mr. President and Ladies and Gentlemen, Members and Friends of the New England Water Works Association: I confess I hardly know just the word to say to you at this time. I anticipated listening to the welcome of Mayor Collins, and I feel somewhat at a loss to know how to say the proper or fitting word. My only excuse for appearing before you is that I am willing and feel it my duty, as I always do, to respond to the request or command of my superiors. When our President requested me to say something this morning I hesitated at first; but thinking it might possibly relieve him somewhat of his embarrassment in the absence of the mayor, I consented to spend a few moments in trying to voice, if I might, something of the thoughts and feelings which fill our minds as we are here assembled.

Certainly Boston has for you, I know, a gracious welcome, and if the duties of its chief official do not permit him to be present to express it, I think you will be sure before the week ends that Boston does welcome you and that you will find, wherever you may go, she offers you every inducement and every encouragement to be bright and merry. I know how difficult it is sometimes when we meet in an assembly like this to throw off the labors and responsibilities and

burdens of life. We can come together for conference, we can grasp the glad hand, but back of it all and over it all there still rest the responsibilities of life, public and private, social and mercenary. But for a little while, at any rate, let us try to draw the curtain over all that, and for the present to enjoy ourselves to the limit; and I assure you that so far as I am personally concerned it will be my duty and pleasure, so far as I am able, to assist in every way possible in promoting the enjoyment of this occasion.

To my mind the power and the benefit of these conventions cannot be overstated or overestimated; and an obligation, it seems to me, rests upon every member of the organization to participate heartily in our duties and pleasures. It is the rubbing together, it is the sense of companionship, that gives us strength for carrying the burdens of life and its duties, and in such gatherings as this many things that trouble us and perplex us are oftentimes rolled away. You know how sometimes we will wake up in the night with a deep sense of oppression because of some responsibility, and how we will lie awake, perhaps, and toss and plan and figure the thing out, but when daylight comes the perplexity is all gone and the thing does not look at all as it did in the night. It is not half as ponderous and not half the bugbear it appeared to be. And it is just the same when we come into a convention of this kind. We say we will lock up our desks and we will drop our cares for a few days anyway, and we make a file of our papers and put them out of sight and come here and meet our neighbors and friends; and we discuss and we confer, we hear of their projects, and we try to help each other out of our difficult places, and when we go back and open our desks and take out our papers and take up our work again we find that our difficulties have solved themselves, matters have all been straightened out, and the things which seemed so burdensome to us before are now disposed of with ease and dispatch. You know the statement is made that there is no friendship that is so thoroughly cemented as the friendship which is formed over the broken bread. And so, when we get together in a convention like this, it makes us glad to be alive, and it simplifies our duties and helps us in every way. I trust that this will be the result of this meeting, and that when the week closes and we are obliged to say farewell, we will say that it has been the most helpful and most enjoyable convention that the New England Water Works Association has ever held.

NEW MEMBERS ELECTED.

The Secretary read the following names of applicants for membership, who were recommended by the Executive Committee: —

For Resident Member.

H. V. Macksey, Boston, Division Superintendent, Street Department.

Edward Phillip Walters, Boston, Biologist Metropolitan Water and Sewerage Board.

Fred J. Taylor, Westboro, Chief Engineer and Superintendent of Water Works at the Westboro Insane Hospital.

William E. Johnson, West Hartford, Conn., Assistant Engineer, Hartford Water Works, and Engineer for the Board of Water Commissioners of Hartford.

For Non-Resident Member.

Joseph T. Miller, Edgewood, Pa., with Pennsylvania Water Company.

John W. Hill, Philadelphia, Pa., Chief Engineer Bureau of Filtration.

I. A. Canals, Civil Engineer, Santurce, Porto Rico, City Engineer of San Juan.

For Associate.

The Stillwell-Bierce & Smith-Vaile Co., Boston, Steam and Power Pumping Machinery, Feed-water Heaters, Water Wheels, etc.

John M. Holmes, Philadelphia, Salesman.

Jenkins Bros., Boston, Manufacturers of Jenkins Bros.' valves, pump valves, and Jenkins' "96" sheet packing and other steam specialties.

On motion of Mr. Brackett, the Secretary was directed to cast the ballot of the Association for the applicants, which he did, and they were declared elected.

The Secretary read the following communication: —

BOSTON, September 10, 1902.

TO THE EXECUTIVE COMMITTEE OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

Gentlemen, — The constitution of our Association provides for the election to honorary membership of men eminent in work connected with hy-

draulic engineering or water supply. We have among our members one who for many years has been eminent in his profession, who has been intimately connected with some of the most important questions relating to water supply which have been under consideration in the United States. I refer to Mr. Alphonse Fteley, formerly Chief Engineer of the Croton Aqueduct Commission, and for many years connected with the engineering department of the Boston Water Works.

Mr. Fteley has taken a deep interest in this Association, and although always very busy and not physically strong, he has at considerable personal inconvenience on several occasions given the Association the benefit of his long and varied experience. On account of failing health Mr. Fteley has for several years not been able to continue the practice of his profession, but I know that he still takes an interest in all questions relating to water supply as well as in this Association. I believe that the grade of honorary membership in our Association should be given only to men eminent in their profession, and I also believe that no more fitting candidate for that grade of membership can be found than Mr. Alphonse Fteley, who I suggest be elected an honorary member of the Association.

Respectfully yours,

DEXTER BRACKETT.

The Secretary stated that the letter had been considered by the Executive Committee, and that the committee had unanimously voted to recommend Mr. Fteley for honorary membership.

On motion of Mr. Robert J. Thomas, the Secretary was directed to cast the ballot of the Association in favor of the election of Mr. Fteley as an honorary member, and this having been done, he was declared elected.

The meeting then adjourned till 2 P.M.

At the afternoon session the Hon. J. O. Hall, Ex-Mayor of Quincy, Mass., read a paper entitled, "Duties of Municipalities Regarding Water Supply." It was discussed briefly by Messrs. Freeman C. Coffin and M. N. Baker.

Mr. Freeman C. Coffin, Chairman of the Committee on "Standard Specifications for Cast-Iron Pipe," submitted the report of the committee. It was discussed by Messrs. Leonard Metcalf, Charles W. Sherman, Dexter Brackett, a member of the committee, Morris Knowles, G. H. Benzenberg, W. C. Hawley, F. N. Connet, Robert S. Weston, Edward V. French, and John C. Whitney; and on motion of E. H. Gowing the report was accepted and the specifications adopted as the standard of the New England Water Works Association.

At the evening session Mr. Frederic P. Stearns, Chief Engineer of the Metropolitan Water and Sewerage Board, gave an illustrated talk on "Recent Construction on the Metropolitan Water Works"; and Mr. Horace G. Holden, Superintendent, Nashua, N. H., read a paper on "The Water Supply of Nashua, N. H."

THURSDAY, SEPTEMBER 11.

At the opening of the morning session the following named were elected members of the Association: —

Non-Resident Member.

A. A. Knudson, New York, Electrical Engineer, engaged in investigation of the effects of electrolysis upon water-piping systems.

Associates.

Wm. V. Briggs, New York, Cast-iron and Wrought-iron Pipe, Supplies, etc.

Wm. H. Greenwood, Everett, Mass., Railway, Steamship, Mill and Water-works Supplies.

A paper giving a description of a new turbidimeter, contributed by Charles Anthony, Jr., Civil Engineer, Glenview, Hereford, England, was read by Charles W. Sherman. Remarks were made upon the subject of the paper by Messrs. Allen Hazen, F. N. Connet, and C. W. Sherman.

Mr. C. W. Sherman called attention to the fact that the constitution of the Association provides that at a business meeting during the annual convention a committee shall be appointed or elected, in such manner as the meeting shall see fit, to nominate officers for the ensuing year, and moved that the President be empowered to appoint such a committee. The motion was adopted, and the President appointed Messrs. Desmond FitzGerald, F. H. Crandall, Byron I. Cook, Joseph E. Beals, and V. C. Hastings as the committee.*

Mr. H. W. Clark, Chemist, Massachusetts State Board of Health, then read a paper on "The Removal of Color and Odor from Water."

The next business was the report of the Committee on "Apportionment of Charges for Private Fire Protection and the Means of

* Mr. FitzGerald having declined to serve, the President subsequently appointed Mr. George F. Chace in his place.

Controlling the Supply Thereto." Mr. F. H. Crandall, Chairman of the committee, reported that they had been unable to agree, and submitted a brief report in behalf of Messrs. Walker, Hammond, and himself; Mr. Edward V. French submitted a report concurred in by Messrs. Cook, Fiske, and himself; and Mr. John C. Chase presented an individual report.

Mr. Washington Paulison moved that Mr. Crandall's report be received and approved by the Association. The several reports were discussed by Messrs. Allen Hazen, W. C. Hawley, Frank C. Kimball, and R. C. P. Coggeshall, and the various members of the committee elaborated their positions.

Without action upon the report, upon motion of Mr. R. J. Thomas, the convention adjourned until 2 P. M.

Upon reassembling, Mr. Fred Brooks moved that the three reports be received and printed. The motion was seconded and adopted.

Mr. F. H. Crandall moved that the Chair appoint a committee of three water-works men, residing within fifty miles of one another, and within one hundred miles of Boston, to take up the question of Private Fire Services with committees of other societies. The motion was adopted.

Subsequently, on motion of Mr. F. C. Kimball, this vote was reconsidered. Mr. Kimball then presented a motion that the President appoint a committee of three, whose duty it shall be to ask for the appointment of and to confer with similar committees from the American Water Works Association, and other kindred associations, and also with the various underwriters' associations, to agree, if possible, upon some adequate means of controlling private fire supplies acceptable to all parties concerned, including therein all questions relating to charges therefor and similar matters. Mr. Crandall having accepted this as a substitute for his original motion, it was adopted.

On motion of Mr. Thomas, the committee was honorably discharged.

Mr. Allen Hazen, Civil Engineer, New York City, read a paper entitled, "The Physical Properties of Water." Mr. R. S. Weston discussed at some length the matters suggested by the paper.

Mr. Charles W. Sherman submitted, on behalf of the Committee on Uniform Statistics, its report. Dr. E. M. Hartwell, Secretary of the Boston Statistics Department, addressed the convention upon the subject of uniform statistics, after which, on motion of Mr. F.

H. Crandall, the report of the committee was accepted and its recommendations adopted. The committee was continued.

Mr. Henry F. Jenks, of Pawtucket, submitted the following report on Exhibits: —

List of Exhibitors at the Twenty-first Annual Convention.

HAROLD L. BOND & CO., Water Works Supplies, Boston.
CHARLES A. CLAFLIN & CO., Water Works Supplies, Boston.
COFFIN VALVE COMPANY, Boston.
GARLOCK PACKING COMPANY, Boston.
HERSEY MANUFACTURING COMPANY, Meters, Boston.
HENRY F. JENKS, Drinking Fountains, Pawtucket, R. I.
LAMB & RITCHIE, Tin Lined Iron Pipe, Cambridge, Mass.
LEAD LINED IRON PIPE COMPANY, Wakefield, Mass.
H. MUELLER MANUFACTURING COMPANY, Water Works Supplies, Decatur, Ill.
NATIONAL METER COMPANY, Meters, New York City.
NEPTUNE METER COMPANY, Meters, Long Island City, N. Y.
PERRIN, SEAMANS & CO., Water Works Supplies, Boston.
PITTSBURG METER COMPANY, Meters, East Pittsburg, Pa.
EDWARD ROBINSON, The Wells Light, New York.
A. P. SMITH MANUFACTURING COMPANY, Tapping Machines, Newark, N. J.
SUMNER & GOODWIN COMPANY, Water Works Supplies, Boston.
SWEET & DOYLE, Vincent Valves, Boston.
THOMSON METER COMPANY, Meters, Brooklyn, N. Y.
UNION WATER METER COMPANY, Meters, Worcester, Mass.
WALWORTH MANUFACTURING COMPANY, Water Works Supplies, Boston.
JENKINS BROTHERS, Valves, Packing, etc., Boston.
N. W. STEARNS, Water Filter, Roxbury, Mass.
F. W. GOW, Meter Testing Apparatus, Medford, Mass.
STILLWELL-BIERCE & SMITH-VAILE COMPANY, Pumps, Dayton, Ohio.
A. W. CHESTERTON & CO., Water Works Supplies, Boston.
LIBRARY BUREAU, Card Filing Devices, Boston.

The report was accepted.

The following new members were elected: —

Resident Members.

John W. Lynch, Brookline, Engineer at Pumping Stations Boston and Metropolitan Water Works.

Harold K. Barrows, Assistant Professor of Civil Engineering at the University of Vermont, Burlington, Vt.

Associate.

Library Bureau, Boston, Makers of Card Index Systems.

THE PRESIDENT. This concludes the more formal proceedings of this convention, to-morrow being devoted to our excursion. Personally, and I think I may say in behalf of the entire official staff, I desire to thank you for the interest which you have manifested in our work by your attendance at the meetings, and for the support and encouragement which you have given your officers in the performance of their duties. If there is no other business to come before the meeting we will now adjourn.

The convention then adjourned until evening.

At the evening session, Mr. Desmond FitzGerald, Engineer Sudbury Department, Metropolitan Water Works, gave an illustrated talk on "What an Engineer Saw in Venice."

Mr. R. C. P. Coggeshall, of New Bedford, gave an historical address, "Twenty Years After: A Retrospect."

EXCURSION TO METROPOLITAN WATER WORKS.

FRIDAY, SEPTEMBER 12, 1902.

Friday, September 12, was devoted to a visit to the Wachusett Dam and North Dike, at Clinton, and the Weston Aqueduct and Reservoir in Wayland and Weston. A special train, furnished by the courtesy of the Boston & Maine Railroad Company, left the North Union Station at 8.45 A.M., and arrived at the dam at Clinton about 10 A.M. After inspecting the work at the dam, the party walked to the North Dike, a distance of about one mile, where the soil which is being stripped from the reservoir is being deposited. A short distance below the dam a tunnel and the pedestals for a viaduct on the re-location of the Central Massachusetts Railroad may be seen.

The party returned to the dam and took the train promptly at 11.40 A.M., for Wayland, where it arrived at 12.25 P.M. Lunch was served at the Town Hall in Wayland. After lunch the Association was called to order by the President, and upon motion of Mr. Coggeshall the thanks of the Association were voted to the Boston & Maine Railroad Company and to the Metropolitan Water and Sewerage

Board, for courtesies extended. At 1.30 P.M. barges were taken for a drive of about twelve miles along the line of the Weston Aqueduct. The laying of riveted steel pipe seven feet in diameter, the construction of the masonry aqueduct and of the Weston Reservoir were inspected. At the crossing of the Charles River the construction of a coffer dam, which is to be used in laying three lines of 60-inch pipes under the river, was seen. The party returned to Boston on a train leaving Auburndale at 5.45 P.M., reaching Boston at 6.12 P.M.

The program and statistics relating to the works visited are as follows: —

Commonwealth of Massachusetts.

METROPOLITAN WATER WORKS.

VISIT OF THE NEW ENGLAND WATER WORKS ASSOCIATION TO THE WACHUSETT DAM AND DIKE AND TO THE WESTON AQUEDUCT, RESERVOIR, AND PIPE LINES, FRIDAY, SEPTEMBER 12, 1902.

The forenoon program includes an inspection of the work at the Wachusett Dam, at the North Dike, and along a portion of the relocation of the Central Massachusetts Railroad in the vicinity of the dam. The party will arrive at the dam at about 10.00 A.M., and will start to walk from the dam to the North Dike at 10.30. The trip to the North Dike will extend only to the middle of the easterly portion, and the party will return without delay, reaching the dam again about 11.15.

The remaining time can be spent in examining the tunnel and other work on the relocation of the railroad a short distance below the dam, and in further inspection of the dam.

Those who wish to see the central power plant which furnishes compressed air for all operations at the dam, quarry, and tunnel, and the quarry from which stone for the dam is obtained, can do so by omitting the trip to the North Dike, and after visiting these works they may take the train at 11.50, at the platform on the Central Massachusetts Railroad just west of the power station.

The train will leave the dam promptly at 11.40 A.M.

The afternoon program includes an inspection of points of interest on the easterly half of the Weston Aqueduct and of a portion of the pipe line which is to convey water from the aqueduct to a point near Chestnut Hill Reservoir.

Opportunity will be given to inspect the laying of riveted steel pipe 7½ feet in diameter, the construction of the masonry aqueduct with special

appliances for crushing, screening, and mixing concrete at Section 11, the construction of the Weston Reservoir, the building of a coffer dam which is to be used in laying three lines of 60-inch cast-iron pipes under the Charles River, and pipe laying in the Newton Boulevard.

STATISTICS.

Wachusett Dam.

Length of main dam between terminal structures	850 feet.
Length of waste weir	450 feet.
Height of top of main dam above full-reservoir level	20 feet.
Maximum height of dam above rock foundation, about	205 feet.
Present height of dam above rock foundation, about	85 feet.
Maximum thickness of dam at bottom, about	185 feet.
Thickness of dam at full-reservoir level	25 feet.
Maximum depth of water above dam	129 feet.
Masonry required for dam	280 000 cu. yds.
Contractor	McArthur Brothers Company, of Chicago.
In charge of work for contractor	Winston Brothers and Locher.
Amount of contract	$1 603 635.
Date specified for completion of dam	November 15, 1904.

The air-compressing plant includes: two double Rand compressors, operated by two compound, condensing Corliss engines of 500 horse-power each.

The two Lidgerwood cableways at the dam have each a span of 1,150 feet, and a capacity of 8 tons. The easterly and westerly movable towers which support the cableways are, respectively, 60 and 90 feet in length.

North Dike.

Length on water side	2 miles.
Height to full-reservoir level at deepest place	65 feet.
Maximum width of base	1 930 feet.
Area covered by dike	143 acres.
Contents of dike	5 500 000 cu. yds.
Total length of cut-off trench	9 556 feet.
Length of cut-off trench excavated to solid rock	3 124 feet.
Length excavated to fine sand	6 432 feet.
Length of cut-off trench where sheet piling was driven	5 245 feet.

Wachusett Reservoir.

Area of watershed	118.23 sq. miles.
Elevation of water level of full reservoir above Boston city base (low tide)	395 feet.
Water surface, 4 195 acres, or	6.56 sq. miles.
Total contents	63 068 000 000 gals.
Length	8.41 miles.
Maximum width	2.05 miles.
Maximum depth	129 feet.
Average depth	46 feet.
Total length of shore, not including islands	35.4 miles.
Length of railroad flooded	6.56 miles.
Length of highways flooded	19.21 miles.

The land required for this reservoir contained 6 large mills, 8 school-houses, 4 churches, and about 360 dwelling-houses occupied by upwards of 1 700 people.

The buildings, vegetation, and surface soil are being removed from the reservoir. The soil has been removed from about two thirds of the area of the reservoir, and at the end of this year the area stripped will be about four fifths of the whole.

Relocation of Central Massachusetts Railroad.

The new line of the railroad is to leave the present line just west of the bridge over the New York, New Haven & Hartford Railroad at West Berlin, and it will run so as to pass over the valley of the Nashua River just below the dam, then continuing along the shore of the reservoir to the North Dike, and across the dike behind its crest to a junction with the Worcester, Nashua & Portland Division of the Boston and Maine Railroad, which it will follow to Oakdale.

There is unusually heavy work on the line of the railroad, including a tunnel 1 063 feet long on the easterly side of the Nashua River, a viaduct 917 feet long across the valley of the river, with a maximum height above the bed of the river of 132 feet, and a rock cut having a maximum depth of 60 feet on the westerly side of the river.

Weston Aqueduct.

The aqueduct, starting at the Sudbury Dam, runs easterly for a total distance of 13.44 miles, through the towns of Southboro, Framingham, Wayland, and Weston, to the high land a short distance west of the Charles River nearly opposite Norumbega Park.

For the first 3½ miles it was feasible to obtain a fall of 4 feet in 5 000, while for the remainder of the distance down to the reservoir only 1 foot in 5 000; consequently the aqueduct, although everywhere of a daily capacity of 300 000 000 gallons, is of different sizes, the upper portion being 10 feet wide by 9 feet 3 inches high, and the lower portion 13 feet 2 inches wide by 12 feet 2 inches high.

The aqueduct is constructed chiefly of concrete masonry, but the lower half has a lining of one course of brick masonry.

There are several special sections, as follows: —

Three 5-foot cast-iron pipe-lines from Sudbury Dam to head-house.

One 7½-foot riveted steel pipe-line across the Sudbury River and Happy Hollow valleys, having, respectively, lengths of 3 603 and 1 123 feet, to be supplemented in the future by two additional lines.

Five tunnels to be lined with Portland cement concrete, and having a total length of 2.30 miles.

An open channel ¼ of a mile long, in Weston, just above the reservoir.

The estimated cost of the aqueduct, including the reservoir, is about $3 200 000.

Weston Reservoir.

The Weston Reservoir and open channel leading to it have a total length of about a mile, and for this distance the masonry aqueduct will be omitted.

The lower end of the reservoir is rather more than a mile above the terminus of the aqueduct. It is constructed for the purpose of equalizing the flow of water and preventing the aqueduct from being surcharged toward its lower end.

The area of the reservoir is 60 acres, or just half that of Chestnut Hill Reservoir.

The minimum depth will be 11 feet and the maximum depth 28 feet.

The surface of the reservoir will be 200 feet above mean low water, making it 37 feet above Spot Pond and 66 feet above Chestnut Hill Reservoir.

The dam will be constructed of earth, with a core-wall of concrete masonry resting upon rock.

Drains will convey all polluted and nearly all other local water past the reservoir into the brook below it.

Supply Pipe Lines.

From the terminal chamber of the aqueduct, the water is to be distributed to different points in the Metropolitan Water District through cast-iron pipes running in different directions.

One line of pipes is now being laid through the city of Newton, much of the way through the Newton Boulevard, as far as Chestnut Hill Reservoir, where it will connect with existing pipes. This line, which is 7.4 miles long, is 60 inches in diameter from the terminal chamber to the easterly side of the Charles River, and 48 inches in diameter for the remaining distance.

November Meeting.

Hotel Brunswick, Boston,
November 12, 1902.

President Frank E. Merrill in the chair; Willard Kent, Secretary.

The following members and guests were in attendance: —

Members.

Charles H. Baldwin, L. M. Bancroft, J. E. Beals, George Bowers, Dexter Brackett, E. C. Brooks, Fred Brooks, G. F. Chace, J. C. Chase, F. C. Coffin, R. C. P. Coggeshall, L. E. Daboll, L. S. Doten, J. N. Ferguson, H. F. Gibbs, Albert S. Glover, Amos A. Gould, John O. Hall, V. C. Hastings, T. G. Hazard, Jr., H. G. Holden, Willard Kent, G. A. Kimball, L. P. Kinnicutt, C. F. Knowlton, A. E. Martin, F. E. Merrill, H. V. Macksey, F. L. Northrop, J. H. Perkins, W. W. Robertson, E. M. Shedd, C. W. Sherman, G. T.

Staples, G. A. Stacy, R. J. Thomas, H. L. Thomas, W. H. Thomas, D. N. Tower, G. W. Travis, W. H. Vaughan, R. S. Weston, G. E. Winslow. — 43.

ASSOCIATES.

Ashton Valve Co., by C. W. Houghton; Barr Pumping Engine Co., by William McLaughlin; Harold L. Bond & Co., by Harold L. Bond; Builders Iron Foundry, by F. N. Connet; Chapman Valve Mfg. Co., by Edward F. Hughes; Charles A. Claflin & Co., by Charles A. Claflin; Coffin Valve Co., by H. L. Weston; A. W. Chesterton & Co., by W. H. Greenwood; Hersey Mfg. Co., by Albert S. Glover and Francis C. Hersey, Jr.; Lead Lined Iron Pipe Co., by Thomas E. Dwyer; Ludlow Valve Mfg. Co., by H. F. Gould; National Meter Co., by Charles H. Baldwin and J. G. Lufkin; Neptune Meter Co., by H. H. Kinsey; Perrin, Seamans & Co., by James C. Campbell; Thomson Meter Co., by S. D. Higley; Union Water Meter Co., by Frank L. Northrop; United States Cast Iron Pipe and Foundry Co., by W. B. Franklin. — 19.

GUESTS.

W. A. Daggett, Jr., Natick, Mass.; J. F. Gleason, Quincy, Mass.; George H. Partridge, *Engineering Record*, Boston, Mass.; Prof. Ira N. Hollis, Harvard University, Cambridge; Prof. Edward F. Miller, Massachusetts Institute of Technology, Boston. — 5.

(Names counted twice. — 3.)

The Secretary read the names of the following applicants for membership, who were recommended for election by the Executive Committee: —

For Resident Member.

George A. Sanborn, Superintendent, Essex Company, Lawrence, Mass.

Harry E. Barnard, Chemist, State Board of Health, Concord, N. H.

D. A. Heffernan, Superintendent of Water Works, Milton, Mass.

For Non-Resident Member.

Robert E. Horton, Hydrographer, U. S. G. S., Utica, N. Y.

John W. Alvord, Civil Engineer, Chicago, Ill.

David Dexter Clarke, Engineer of Water Committee, Portland, Ore.

J. H. Ince, Assistant to President, Western New York Water Co., Buffalo, N. Y.

William R. Conard, Inspector of Materials, Burlington, N. J.

R. O. Wynne-Roberts, Water Engineer to the City of Capetown, South Africa.

On motion the Secretary was directed to cast the ballot of the Association for the applicants, which he did, and they were declared elected.

A letter from Mr. Alphonse Fteley, accepting his election as honorary member, was read by the Secretary.

The President announced his appointment of Messrs. F. H. Crandell, R. J. Thomas, and Elbert Wheeler, as the Committee on Private Fire Services, in accordance with a vote passed at the convention in September.

Prof. Ira N. Hollis, of Harvard University, was introduced, and spoke on the economic use of fuel in steam plants. Prof. L. P. Kinnicutt, in discussion, spoke of the chemist's views of combustion and of some chemical methods of attaining high temperatures.

Prof. Edward F. Miller, of the Massachusetts Institute of Technology, read a paper on "The Sulphurous Anhydride Waste-heat Engine."

Adjourned.

MEETINGS OF THE EXECUTIVE COMMITTEE.

The Executive Committee met before the meeting of the Association on September 10; present, President Merrill, Messrs. Kent, Brooks, Bancroft, Hammond, Holden, Stacy, Thomas, C. W. Sherman, and Walker. Applications for membership were approved. A letter was received from Mr. Dexter Brackett, suggesting the election of Mr. Alphonse Fteley as an honorary member of the Association. It was voted that the Executive Committee recommend the election of Mr. Fteley as an honorary member.

Adjourned.

The Executive Committee met at Tremont Temple, on October 16, 1902. The question of the place for holding the November meeting was raised, and after discussion it was unanimously voted that it be at the Hotel Brunswick.

The editor, Mr. Sherman, brought up the question of a general index to the JOURNAL. He said that for more than two years he has been trying to prepare such an index, but had not yet succeeded in making much progress. It was voted that Mr. Sherman be authorized to confer with the Library Bureau regarding the preparation of such an index.

Adjourned.

The Executive Committee met at Tremont Temple, at 11.30 A.M.; present, President F. E. Merrill, Secretary Willard Kent, and Messrs. Brooks, Thomas, Holden, Bancroft, C. W. Sherman, and Stacy. Nine applications for membership were approved. The Editor, Mr. Sherman, reported the result of his conference with the Library Bureau, regarding the preparation of a general index to the JOURNAL, and it was voted that he be authorized to have such an index prepared and printed.

Adjourned.

After the meeting of the Association on November 12, the Executive Committee again came together and voted unanimously to hold all the winter meetings at the Hotel Brunswick.

Adjourned.

OBITUARY.

George A. Hotchkin, superintendent of the Bureau of Water, Rochester, N. Y., died in that city on October 6, 1902.

Mr. Hotchkin was born in Caledonia, N. Y., in 1853, but his parents removed to Rochester while he was an infant. He was educated in the Rochester schools, and fitted himself for the profession of civil engineering. In 1874 he began work on the engineering force in connection with the first conduit from Hemlock Lake, and, with the exception of three or four years spent in contracting work, had been connected with the water department of Rochester continuously since that date. He became superintendent on January 1, 1900. His long experience in the department had familarized him with all its details, and he was regarded by superiors and subordinates alike as a faithful and capable official.

He was stricken suddenly while dining at the Whist Club, in company with City Engineer Fisher, and lived but little more than an hour. He is survived by his wife.

The following resolution was adopted by the heads of the city departments: —

Death has struck down without notice our comrade and genial companion, George A. Hotchkin, superintendent of water works. It is fitting that we should voice the sentiment which we all feel, that Rochester has lost an able, honest, and efficient official and a good citizen, and we have lost a liberal-minded, kind-hearted friend. We extend to his dearly beloved wife our heartfelt sympathy in this her direst bereavement.

Mr. Hotchkin was elected a member of the New England Water Works Association on June 13, 1900.

BOOK NOTICES.

"The Municipal Year Book, 1902; Giving the Population, Assessed Valuation, Principal Officials, and Ownership of Public Utilities, also Information regarding the Water Supply, Sewerage, Street Cleaning, Street Sprinkling, Garbage, Fire and Underground Electric Service in all Incorporated Places in the United States, and in all New England Towns of 3 000 Population and Upwards by the Census of 1900. With Summaries and Editorial Discussion." Edited by M. N. Baker, Ph.B., C.E., Associate Editor of *Engineering News*, Editor of the *Manual of American Water Works*, etc. Engineering News Publishing Co., New York. $3.00.

This is indeed "an encyclopædia of municipal news and statistics." The various statistics listed in the sub-title are given briefly for each city or town in the body of the book, and, in addition, the information of most general interest is tabulated or summarized in the introduction, and so arranged as to show the extent of municipal and private ownership of the several public utilities. A table of water purification plants, showing for each municipality where the water is purified, the kind of purification, ownership of works (whether public or private), and population may be noted as an example of especial interest to Association members, and typical of the manner in which information has been summarized for ready reference and for comparison.

"The Graphical Solution of Hydraulic Problems; Treating of the Flow of Water through Pipes, in Channels and Sewers, over Weirs," etc. By Freeman C. Coffin, M. Am. Soc. C. E. Second edition, revised and enlarged. John Wiley & Sons. New York.

This valuable hand-book is already well known and generally appreciated. It contains tables and diagrams by which all the ordinary hydraulic problems may be quickly solved with explanatory text. The second edition has been enlarged by the addition of several new diagrams and a brief discussion of the flow of water in riveted steel pipes.

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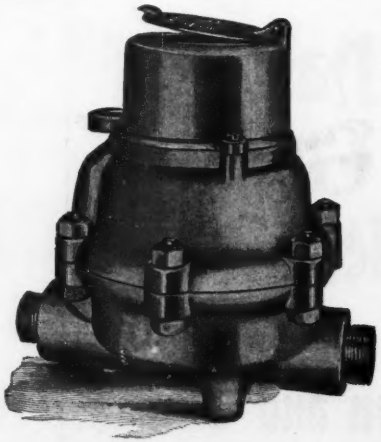

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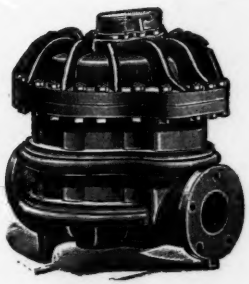

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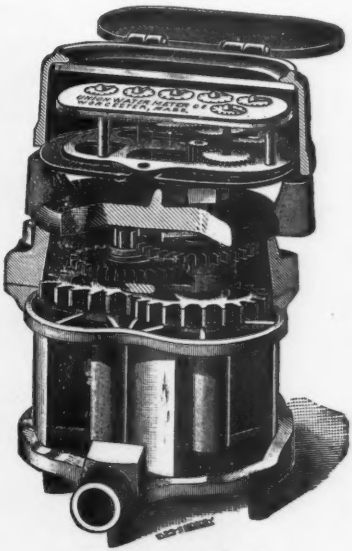

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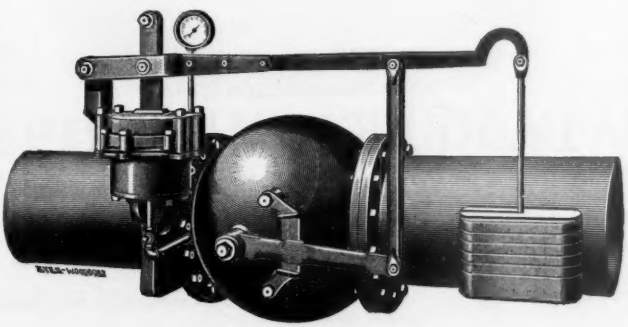

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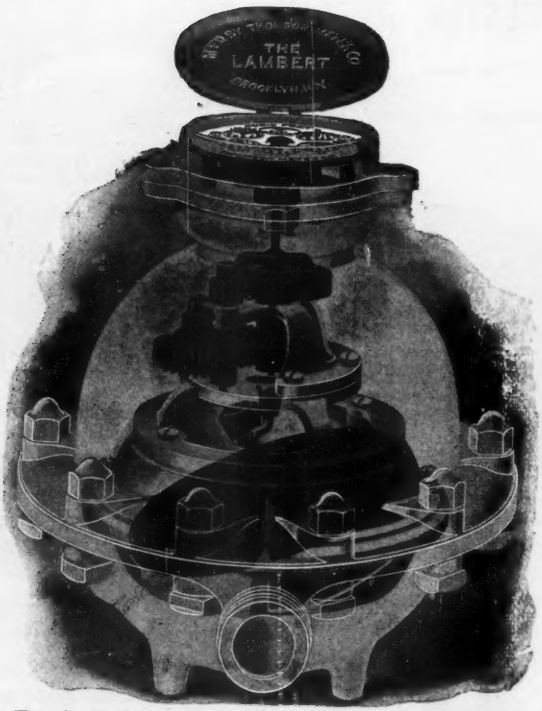

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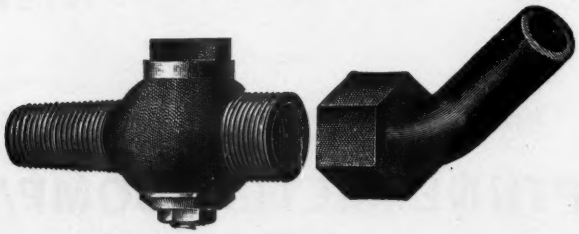

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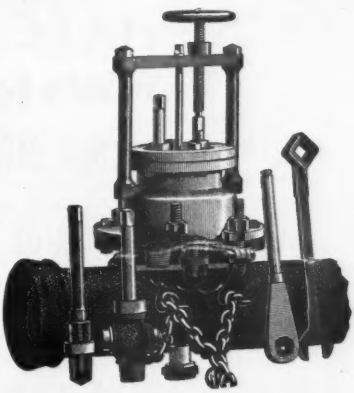

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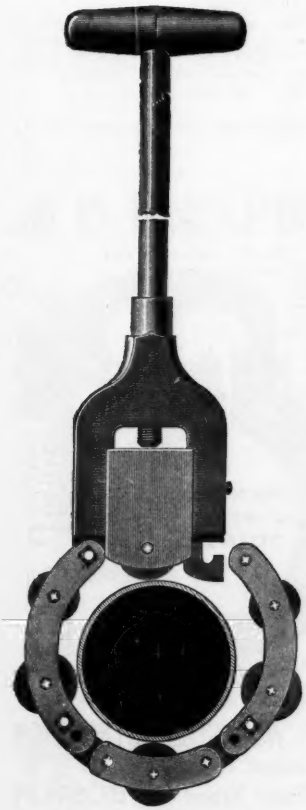

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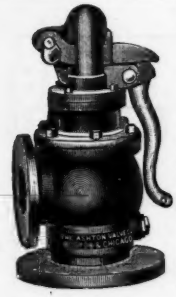

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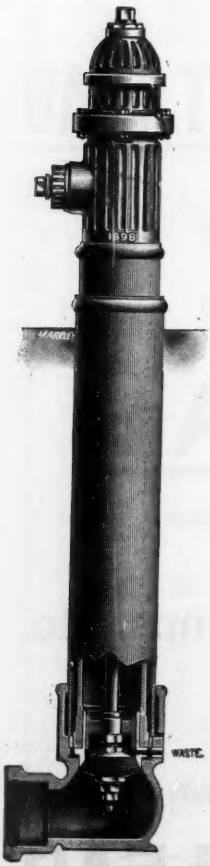

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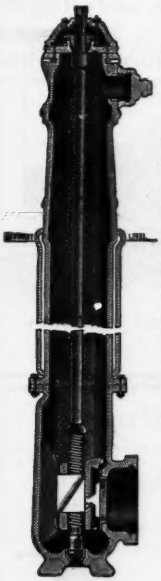

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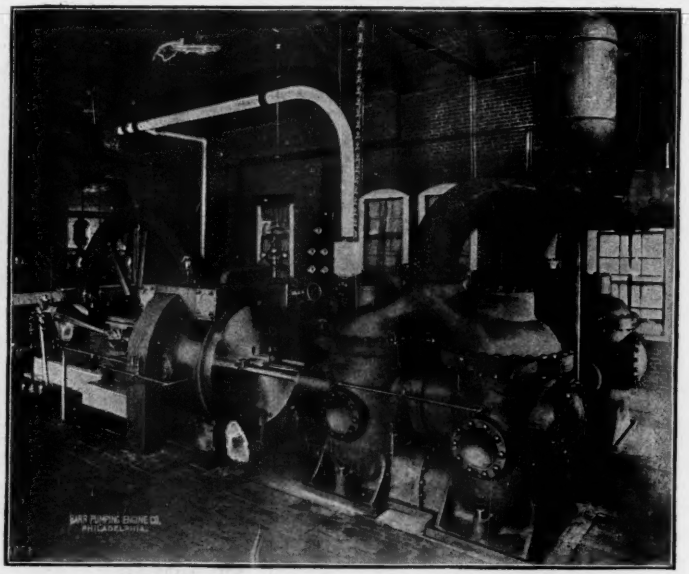

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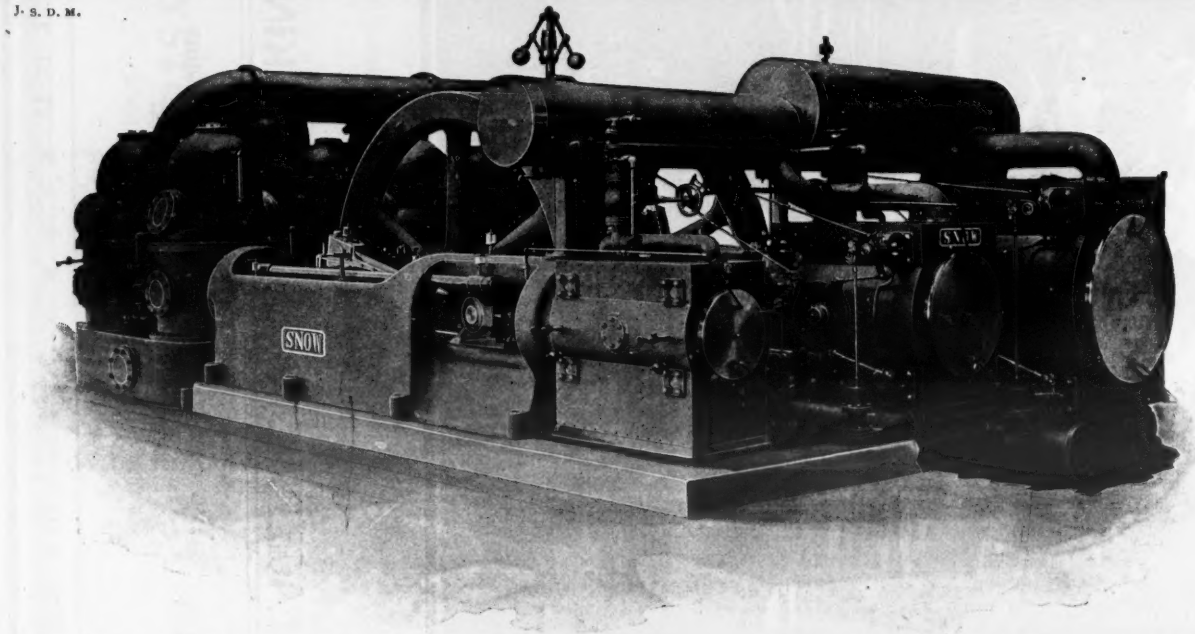

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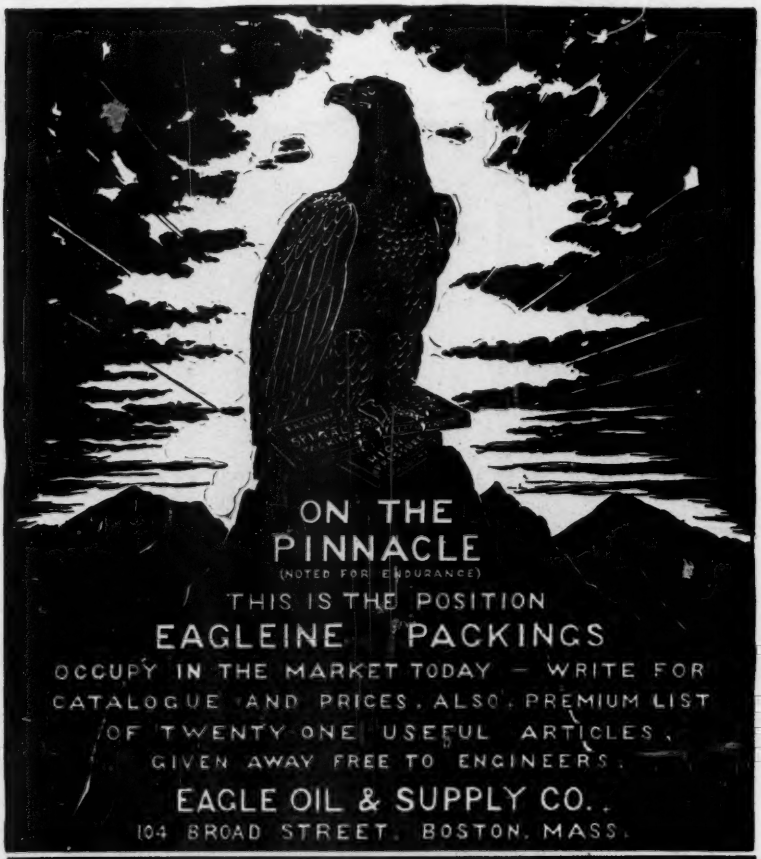
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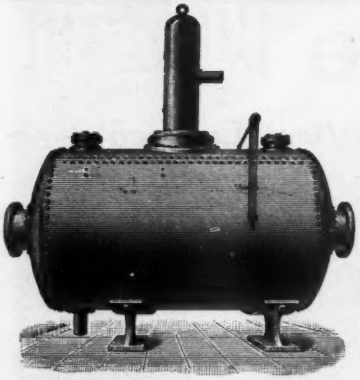

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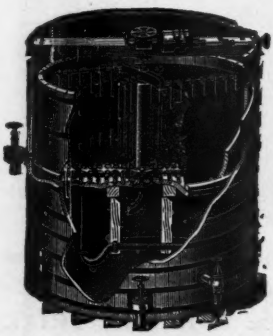

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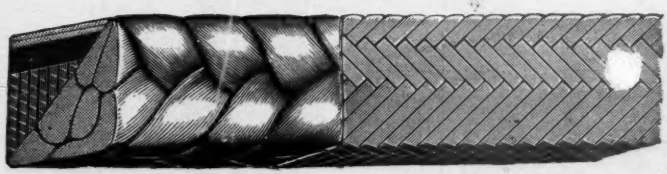

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